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APPENDIX TO THE JOURNALS

OF THE

SENATE AND ASSEMBLY

OF THE

THIRTY-SECOND SESSION

OF THE

LEGISLATURE OF THE STATE OF CALIFORNIA.

VOLUME IV.

SACRAMENTO:
A. J. JOHNSTON, : : : : SUPERINTENDENT STATE PRINTING.
1897.

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UNIVERSITY OF CALIFORNIA.

BIENNIAL REPORT

OF THE

PRESIDENT OF THE UNIVERSITY

ON BEHALF OF THE BOARD OF REGENTS,

TO

HIS EXCELLENCY THE GOVERNOR OF THE STATE.

1894.

SACRAMENTO:
A. J. JOHNSTON, : : : : SUPERINTENDENT STATE PRINTING.
1895.

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REPORT OF PRESIDENT OF THE UNIVERSITY.

Berkeley, California, September 20, 1894.

To His Excellency H. H. Markham, *Governor of the State of California:*

Sir: The last "biennial report" of the Regents of the University, which was for three years instead of two, brought the history of the institution up to the autumn of 1893. Another report is due this year, and may be comparatively brief.

The growth of the University has been this year even more remarkable than in the three years preceding. The following table shows the number of students in attendance in the various departments for the years 1890–91, 1891–92, 1892–93, 1893–94, and for the beginning of the year 1894–95:

	1890–91.	1891–92.	1892–93.	1893–94.	1894–95. To Nov. 26.
In Academic Departments at Berkeley:					
Men	352	383	446	541	676
Women	105	164	204	274	351
Totals	457	547	650	815	1,027
At the Lick Observatory:					
Men	3	4	6	5	6
Women	0	0	0	2	2
Totals	3	4	6	7	8
In the Colleges of Law, Medicine,* Pharmacy, and Dentistry, and in the Mark Hopkins Institute of Art, in San Francisco:					
Men	302	378	415	474	545
Women	9	12	20	92	105
Totals	311	390	435	566	650
Total in the University (deducting for duplicates)	771	941	1,091	1,383	1,685

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*Including the Post-Graduate Medical Department.

The numbers graduated from the several Colleges during 1894 have been as follows:

1894.	Colleges of General Culture.	Colleges of Applied Science.	Law.	Medicine.	Pharmacy.	Dentistry.	Totals.
Men	47	23	30	28	21	18	167
Women	33	1	0	3	1	0	38
Totals	80	24	30	31	22	18	205

The large increase in the number of students has necessitated a further increase of the teaching force. The following table gives a comparative view of the last few years:

Table showing the Number of Professors, Associate Professors, Assistant Professors, Lecturers, Instructors, Assistants, and Fellows in the Colleges at Berkeley during Each Academic Year—Compiled from the Annual Registers.

Year.	Professors.	Associate Professors.	Assistant Professors.	Lecturers.	Instructors.	Assistants.	Fellows.	Totals.
1890–91	17	5	5	2	8	11	....	48
1891–92	17	8	8	....	13	12	2	60
1892–93	16	9	10	1	19	18	4	77
1893–94	17	9	12	....	20	23	7	88

Among the new accessions to the Faculty, the following may be noted:

In the Department of Greek, Professor Edward B. Clapp, late of Yale University.

In the Department of Latin, Professor Wm. A. Merrill, late of the University of Indiana.

In the new Department of Semitic Languages and Literature, Dr. Jacob Voorsanger, who offers his services as Professor gratuitously, until the department can be put on a more substantial foundation.

Associate Professor Henry T. Ardley, late of the University of Minnesota, has begun work in the new Department of Decorative and Industrial Art.

Assistant Professor H. P. Johnson takes the place of Professor Ritter, who is absent for a year's study in Europe.

Dr. Thos. P. Bailey, Jr., Ph.D., of Johns Hopkins, has been added as Assistant Professor to the Department of Pedagogy.

Mr. A. P. Hayne, a graduate of this University, has become Instructor in Viticulture and Olive Culture.

Mr. E. B. McGilvary, A.M., of Princeton, is a new instructor in English.

Additional instruction has been provided in the Departments of Mathematics, Romance Languages, and Drawing.

Associate Professors Jones, Bradley, and Paget have been made Professors in their respective departments.

Professor Greene is spending part of a year abroad, expecting to resume work at home in January, 1895. Dr. Joseph Le Conte attended the August meeting of the American Association for the Advancement of Science, in the City of Brooklyn, and helped to secure a favorable decision for San Francisco as its place of meeting in 1895.

As in the preceding years, Summer Schools were held in the University buildings in the vacation months of this year, by the following departments: In Physics, under the immediate supervision of Instructor Raymond. In Chemistry, under Instructor Sharwood. The railway disturbances defeated certain plans for summer work and observation in the Engineering, Mining, and Geological departments. According to the matured Announcements of Courses, the summer vacation will, as a rule, be utilized by the Technical Colleges for important supplementary work.

The College of Agriculture has continued its work of instruction, correspondence, attendance at Farmers' Institutes, and coöperation with fruit-growers, dairymen, and others. The Experiment Stations have been kept up as usual. The Forestry Stations, turned over to the University by the last Legislature, need a larger allowance than the small sum then appropriated.

The plant-house, for which plans were made several years since, has now come to erection, on the hill sloping down from the Students' Observatory. Its ample spaces will soon be ready for occupation.

A voluminous report of the most important work of the different branches of the Agricultural Department is now in the hands of the printer. It contains observations made by Professor Hilgard during his recent year's absence in Europe; a full report of much laboratory work in analyses of soils, fertilizers, fruits, sugar-beets, etc.; a careful treatise on olive culture; a report on Forestry Stations; and a treatment of many other subjects.

The Department of Mechanical Engineering is now housed in the fine new building put up in 1893. One portion is devoted to electrical engineering, which is now well provided for, both in instruction and in equipment. The full equipment of the building, which is expected to furnish light and power to other buildings, will still be a heavy draft on the ordinary resources of the University.

The Civil Engineering Department is occupying the old mechanical rooms. Its laboratory is fitted up with new machinery for testing the strength of materials used in engineering and architectural construction.

In the Chemical Laboratory there has been an urgent call for help in carrying out the law for the prevention of frauds in olive oil. The Legislature might well make an appropriation for the execution of the law, as the ordinary force in the University laboratory is insufficient to perform the required extra labor. Calls are made upon the department for analyses of water in many different localities. Some of these calls are for public institutions managed by the State; some for municipalities, in the interest of proper sanitation; others for private individuals. But these last raise questions of a sanitary and economical character which affect whole localities.

The Chemical Department is also looked to for analyses of various articles of food, and of commercial medicines and tonics, to detect the numerous frauds by adulteration. It is in the interest of the State to care for the health and the safety of all its citizens. It seems reasonable, therefore, that special arrangements for sanitary advice should be made at the State University, and that a special appropriation should be made for the extra labor imposed on the laboratories.

The Register for the University year 1893–94 was unusually late in appearing, the delay being chiefly due to very considerable changes in the curricula of the several Colleges at Berkeley. It was a year of reconstruction. An important addition to the general courses of instruction was made by the establishment of a College of Natural Sciences. The new College of Social Sciences includes the lines of work before taken in the Literary Course and the Course in Letters and Political Science. The College of Letters, whose name is fixed by the Organic Act, stands now by itself as giving the Classical Course leading to the degree of A.B.

In all these general colleges only half the work is prescribed. One quarter is assigned to group electives, for the study of connected subjects. The remaining quarter is open to free electives entirely at the choice of the student. As was remarked in the last report, this distribution of work seems to be a satisfactory adjustment of the claims of prescribed and elective studies. The experience of the year is in favor of the new organization. With an antecedent choice between so many courses, and with so large an element of subsequent election, no student can reasonably complain that he is shut up to a distasteful curriculum.

The College of Chemistry has also recast its course in such a way as to make half the work elective. The College of Agriculture approaches the same adjustment.

The three Engineering Colleges find it still necessary to prescribe more than half the work; but their curricula have been recast, with a gain in unity, simplicity, and efficiency.

The courses in the Colleges of Letters, Social Sciences, and Natural Sciences have been maintained with increasing vigor, and are taken by a large majority of the students. It is felt that the four years of general study are not too long a preparation for any of the professions which call for intellectual training.

The members of the Faculty at Berkeley continue to give free instruction in a limited number of University Courses at the Mark Hopkins Institute of Art in San Francisco. The lecturers for the year 1893–94 were as follows: In the first half-year, Professor Stringham, Assistant Professor Plehn, and Mr. Syle; in the second half-year, Professor Stringham, Associate Professor Richardson, and Mr. Armes. For the first term of 1894–95, Professors Le Conte and Clapp and Assistant Professor Sanger are already announced. Other Extension Courses have been given, as follows: In Los Angeles, by Professor Gayley; in Sacramento, by Professor Gayley and Assistant Professor Plehn; in San José, by Associate Professor Bacon; in Ventura, by Professor Moses.

The calls for Extension Courses are more than the Faculty can meet, without interfering with their work at Berkeley. We look forward to the time when our teaching staff can be so increased as to justify a greater expansion of our Extension work.

Attention is called to the announcement in the last report, that except in the University's homes, in Berkeley and San Francisco, the responsibility for organizing Extension Courses, and providing for the necessary expenses, will be thrown upon the "local centers." Inquiries in regard to such courses should be addressed to our Extension Secretary, Mr. Wm. D. Armes.

The list of accredited schools has increased to 48 (for 1893–94). For an account of our method, and its resulting benefits, see page 13 of the last report.

Entrance examinations must, of course, be continued, for candidates not coming with suitable recommendations from accredited schools. These examinations have not been impaired in point of thoroughness by the growth of the accrediting system.

Examinations were held this year away from Berkeley, at the following points in the State: Los Angeles, Grass Valley, Chico, Visalia, and Nordhoff.

In the spring of this year the President of the University invited the Principals of high schools and accredited private schools, and City and County Superintendents, to meet the Professors and Instructors of the University for a conference on questions of mutual interest. The invitation met with a favorable response, and a goodly number became, for the day, May 5th, the guests of the President. There was a free discussion of the subjects brought before the conference, and the proceedings were interesting and profitable. To secure more permanent results from the meeting, a committee was authorized to report on the courses of study in our secondary schools. That committee, consisting of Principals W. F. Hall and T. L. Heaton, and Professor F. Slate, has prepared a report which is of so great value that I include it in the appendix to this Biennial Report. The Chairman, Principal Hall, has diligently gathered and collated the facts pertaining to the instruction in our secondary schools.

Reports from the Deans of our Professional Colleges will be found in subsequent pages. These colleges, located in San Francisco, have continued to increase in numbers.

The Hastings College of the Law requires of candidates for admission the same group of subjects as those which are accepted for a limited course in the Academic Department; but more subjects are required.

After this year, the Medical Department will demand a high school or normal school standing of all applicants for admission. Four years of medical study will be required for graduation. Advanced standing, shortening the course one year, may be acquired by the completion of certain preparatory studies in a recognized university or college. The department has always been in the front rank in its requirements for graduation. This professional school is still suffering great injury from its insufficient accommodations. Its able Faculty attracts a goodly number of students; but it is greatly handicapped by the want of a building in a suitable locality. (See the statement of Dr. R. A. McLean in last year's report, and in the appendix to this report.)

The Post-Graduate Medical Department is fully organized, having a teaching staff of seventeen Professors, with over twenty clinical assistants.

The College of Pharmacy requires for a degree two full courses of lectures, and four years of experience in an accredited pharmacy.

The College of Dentistry, which is rapidly outgrowing its rooms, requires for graduation three years of dental study, including experience in all the usual branches of dental work.

The report of Director Holden gives a year's history of the Lick Observatory. More than five thousand visitors record their names every year at the Observatory, besides many who fail to register. The report shows that additional assistance is desired in various lines of astronomical work.

The University exhibit at the Midwinter Fair was in every way successful, and gave to many of our people a new estimate of the work of the State University. "University Day" was celebrated with much interest by the students, the alumni, and the friends of the University. It was graced with the presence of our Chief Magistrate, who presided at the evening banquet; and of distinguished military guests, who accorded high praise to the University Battalion.

The students of the University continue to merit commendation for their good conduct, their industry, and their loyalty. Their athletic sports and other recreations receive public notice in the newspapers; but the unrecorded phases of student life are the true tests of benefit received and time well spent. We are sure that our students will compare favorably with those of other institutions, for their earnestness of purpose and devotion to their proper work.

It should be generally known that a very considerable number of the students are making a fight for an education against the demon of poverty. Some of the very best scholars are without resources. Last spring, when three vacancies in the list of Hearst Scholarships were to be filled, there were over thirty applications from young women who were very highly recommended, to whom pecuniary assistance seemed absolutely necessary. Of the young men, a considerable number are working their way, and some are living on short rations. There is a Students' Aid Society, which is doing much to find places and work for those who are trying to support themselves. This deserving class of students is especially commended to the care of the community. Employment given them is a twofold benefit. Loan funds and scholarships would help many to finish their college courses, and to repay the benefaction by their useful and influential lives.

The needs of the University are still more imperative than at the date of the last report. The Library grows much too slowly for the growth of the University. Occasional donations are thankfully received; the latest being a gift from Mrs. Walsworth, of the large and well-selected private library of the late Rev. Dr. Edward B. Walsworth. For all the students in the general culture courses, the University Library is as important as are the laboratories for the students in applied science. The scientific side of the Library is also in much need of strengthening.

Several new lines of instruction claim immediate attention. The established courses in the fundamental studies are insufficiently manned. There is pressing need of a few endowments, to take a part of the expense of instruction. But the salary-roll could be more nearly provided for, if only we were relieved from the great burden of erecting new buildings.

Within the past few years the University has expended from its income, for new buildings and their equipment, about $180,000. The further equipment of the Mechanical building will cost a large additional sum. These improvements have been on the scientific side of the institution, and seemed indispensable. Of the buildings now in use only three and a half have been erected by legislative appropriations. The others have been a charge on University funds, or are due to private benefactions. The magnificent site of the University at Berkeley came to it without cost.

There is urgent need of the following new accommodations for the thousand students at Berkeley:

An Administration Building, furnishing a safe depository for our records, and leaving two suites of rooms, now occupied, to be turned into class-rooms.

An Assembly Hall for public gatherings. Our largest room will not hold the Freshman class of the current year.

A day-home for young women. Their present quarters are painfully inadequate. One hundred and twenty-five young women entered at the beginning of our new year.

Additions to the Library Building. Rooms are needed for special libraries, and for use by seminary classes. There is now a want of seating-room. Our Library is preëminently one for use, and hundreds of students meet there in the hours between their class-room exercises.

A Museum Building, with four times the space of the present rooms, and adjoining rooms for the three or four departments of science which are dependent on our collections for illustrative material.

An Armory Building with additional room for gymnasium practice. The present gymnasium is quite outgrown, and especially inadequate for the accommodation of the young women.

The doubling of our numbers within the past few years has made it impossible, from our stated income, to provide both for increased instruction and for additional room. It seems absolutely necessary that the State should come in to share the burden. In no other way can we fulfill our obligations to those whom we have invited to our University courses. It is gratifying to see them come: we are in honor bound to satisfy their just expectations.

I have not mentioned the pride of the State in seeing its highest school of learning take a proper rank among the universities of the land. Science and literature alike claim complete facilities for the best education of the modern time. In no way can our State more surely acquire a truly noble reputation, than by winning educational prominence. As Harvard is a chief glory of one State, and Yale of another, and Michigan of the State whose name it bears, so our own University, if wisely fostered and generously supported, may become one of California's highest and most enduring titles to honor among the commonwealths of America.

Subjoined are special reports from the Dean of the Colleges at Berkeley, from the Deans of the Professional Colleges, from the Director of the Lick Observatory, from the Secretary of the San Francisco Art Association, and from the Conference Committee spoken of on a preceding page.

A full list of the published writings of members of the Faculty, covering a period of three years, was printed in the last report. As but a single year has since elapsed, it is thought best to defer additional specifications till another report is issued. But it is due to a few who have come to us within the year, to name their printed productions.

The customary financial statement is also appended.

Respectfully submitted.

MARTIN KELLOGG,
President of the University of California.

SUBSIDIARY REPORTS.

Of the Dean of the Colleges at Berkeley.

Of the University Conference Committee.

Of the Director of the Lick Observatory.

Of the San Francisco Art Association.

Of the Dean of the Hastings College of the Law.

Of the Dean of the Medical Department.

Of the Dean of the Post-Graduate Medical Department.

Of the Dean of the College of Dentistry.

Of the Dean of the College of Pharmacy.

Published Writings of New Members of the Faculty.

Financial Statement.

REPORT OF THE DEAN OF THE COLLEGES AT BERKELEY.

To the President of the University of California:

Sir: I have the honor to submit herewith the following report on attendance and courses of instruction in the Colleges of Letters, Social Sciences, Natural Sciences, Agriculture, Mechanics, Mining, Civil Engineering, and Chemistry, for the academic year 1893–94.

The following table gives the number of students in attendance during the year, classified by status and by colleges. The upper figures on the left of each group refer to young men, the lower to young women; the numbers on the right side of each column are the totals:

Graduates.

Cand. Ph.D.	Cand. A.M.	Cand. M.L.	Cand. M.S.	Graduates pursuing Special Subjects	Total
14 2 16	10 4 14	4 3 7	2 0 2	13 12 25	43 21 64

Undergraduates.

	Seniors.	Juniors.	Sophomores.	Freshmen.	Students at Large.	Special Students	Limited Students	Totals.
Letters	13 5 18	9 6 15	8 2 10	15 5 20	9 8 17	6 5 11	0 2 2	60 33 93
Social Sciences	17 16 33	17 11 28	21 21 42	20 19 39	90 59 149	15 46 61	24 21 45	204 193 397
Natural Sciences	1 1 2	1 1 2	2 0 2	1 1 2	7 6 13	7 3 10	2 1 3	21 13 34
Agriculture	1 0 1	0 0 0	0 0 0	0 0 0	4 0 4	7 4 11	1 0 1	13 4 17
Mechanics	3 0 3	2 0 2	9 0 9	22 0 22	31 1 32	3 1 4	12 0 12	82 2 84
Mining	2 0 2	4 0 4	0 0 0	5 0 5	10 0 10	8 0 8	3 0 3	32 0 32
Civil Engineering	6 0 6	4 0 4	7 0 7	10 0 10	17 0 17	11 0 11	2 1 3	57 1 58
Chemistry	1 0 1	1 1 2	1 0 1	6 0 6	14 1 15	5 7 12	1 0 1	29 9 38
Totals	44 22 66	38 19 57	48 23 71	79 25 104	182 75 257	62 66 128	45 25 70	498 255 753

Total in the Colleges at Berkeley (deducting 2 for duplicates)	541 274 815

The staff of Instruction and Research consisted of ninety-seven persons, namely:

Professors	17
Associate Professors	9
Assistant Professors	12
Instructors	20
Department Assistants	37
Curators	2

The statistics of courses of instruction given, and of attendance in each course, are presented in the following table. In some of the very large classes the attendance varied considerably during the year, and for such classes the figures of the third column are only approximate:

COURSES OF INSTRUCTION GIVEN IN THE COLLEGES AT BERKELEY DURING THE YEAR 1893-94.

Instructor.	Title of Course.	No. of Hours a Week.		No. Students in Attendance
		One Term	Two Terms	
	PHILOSOPHY.			
Howison; Stratton; Henderson	1. Formal Logic	4		47
Howison; Stratton; Henderson	2. Elementary Psychology	4		46
Howison; Stratton; Henderson; Henshaw	3. Introduction to Philosophy	4		34
Howison	4. Elementary Ethics, including Civil Polity		2	18
Howison	5. The Philosophy of Kant		2	15
Howison	7. The Philosophy of Plato		2	4
Howison	8. Hegel's Logic. Seminary		2	
Howison	9. Teachers' Course: The Philosophy of Education		2	
	PEDAGOGY.			
Brown; Miss Wertz	1. The Practice of Teaching	6		19
Brown	2. School Supervision	2		7
Brown	3. The History of Education: Earlier Periods	2		23
Brown	4. The History of Education: The Latest Period	2		30
Brown	5. The Theory of Education	3		13
Brown	7. Seminary for the study of special problems in Education	2		7
Brown	8. Graduate Seminary for the systematic study of child-life			
	HISTORY AND POLITICAL SCIENCE.			
Bacon; Plehn	1. History of Europe during the Middle Ages	4		127
Bacon; Leach	2. Constitutional History of England	4		117
Bacon	3. History of Europe from the Reformation to the French Revolution	4		78
Bacon	4. Political History of the Nineteenth Century	4		73
Haynes	5. History of the English Colonies in America	4		
Haynes	6. Political and Constitutional History of the United States	4		35
Haynes	7. The Constitution and Government of the United States	4		26
Plehn; Leach	8. Comparative Constitutional Law	4		50
Plehn; Haynes	9. Elementary Political Economy	4		82
Jones	10. Elements of International Law	2		40
Haynes	11. Economic History	4		6
Plehn	12. Local Government and Administration	4		

COURSES OF INSTRUCTION—Continued.

Instructor.	Title of Course.	No. of Hours a Week.		No. Students in Attendance
		One Term	Two Terms	
Plehn	13. Finance and Taxation	4	------	20
Moses	14. Economic Theory	4	------	40
Jones	15. Roman Law	4	------	25
Jones	16. Jurisprudence	4	------	18
Moses	17. History of Political Theories	4	------	24
Jones	18. Constitutional Law of the United States	------	2	21
Moses	19. Political Science: Graduate Course	------	------	------
Moses	20. Seminary: Economics and Politics	------	3	3
Moses	21. Spanish-American History	4	------	24
	GREEK.			
Flagg	1. Twelve Books of Homer	3	------	43
Flagg	2. Two Books of Herodotus	3	------	34
Flagg	3. Greek Composition	------	1	18
Newsome	4. Plato, Sophocles	3	------	4
Clapp	5. Tragedy and Lyric Poetry	3	------	5
Clapp	7. Plato	2	------	9
Flagg	8. Euripides	3	------	6
Clapp	9. Aristophanes	2	------	------
Clapp	11. Greek Seminary	2	------	4
	LATIN.			
L. J. Richardson	1. Cicero and Nepos	3	------	78
Flagg; L. J. Richardson	2. Livy, Quintus Curtius; Plautus and Terence	3	------	67
L. J. Richardson	3. Latin Composition	------	1	56
Wentworth	4. The Odes and Epodes of Horace	3	------	36
L. J. Richardson	5. Selected Letters of Cicero and Pliny	3	------	20
G. M. Richardson	6. The Private Life of the Ancient Romans	1	------	9
G. M. Richardson	7. Latin Composition	------	1	11
G. M. Richardson	8. Tacitus: Agricola and De Oratoribus	2	------	9
Flagg	9. Cicero: Brutus and de Oratore	2	------	18
Kellogg	10. Tacitus: Germania and Agricola	2	------	3
G. M. Richardson	11. Cicero's Tusculan Disputations	1	------	2
G. M. Richardson	12. The Elegy: Tibullus and Propertius	3	------	7
G. M. Richardson	13. The Fasti of Ovid; Roman Mythology	3	------	7
G. M. Richardson	14. Horace: Satires and Epistles	3	------	3
Flagg	16. Cicero: Brutus	3	------	17
Flagg	17. Advanced Latin Composition	------	1	14
Flagg	19. Catullus	2	------	17
G. M. Richardson	21. Seminary: Ovid, Fasti	1	------	------
G. M. Richardson	22. Seminary: the Pseudo-Vergilian Moertum	1	------	------
G. M. Richardson	23. Graduate Course: Vergil, Bucolics	2	------	4
G. M. Richardson	24. Graduate Course: Juvenal	3	------	3
Kellogg	25. Linguistics	2	------	4
	ENGLISH.			
Lange; Syle; Sanford	1. (*a*) Types of English Prose Style	------	3	235
	(*b*) Supplementary Reading	------	1	235
Armes	2. Practical Rhetoric and Summaries	5	------	177
Armes	3. (*a*) Shorter Course in Prose Style (*b*) An Outline of English Literature	4	------	87
Bradley	4. General History of English Literature	------	3	77
Lange	5. Old English	2	------	20
Lange	6. The Principles of Rhetoric	2	------	21
Lange	7. Poetics	2	------	34
Lange; Armes; Syle; Sanford	8. Themes. (*a*) Freshman year	------	1	180
	(*b*) Sophomore year	------	1	79
Lange	9. Old English Poetry	3	------	20
Armes	11. (*a*) Introduction to the English Drama	2	------	12
	(*b*) The History of the English Drama	2	------	13
Lange	12. Milton and His Contemporaries	3	------	------
Bradley	13. The English Language and Grammar	2	------	9

Courses of Instruction—Continued.

Instructor.	Title of Course.	No. of Hours a Week.		No. Students in Attendance
		One Term	Two Terms	
Gayley	14. Oratorical Training. (*a*) Forensics	2	------	34
Syle	(*b*) Training in Oratorical Expression	2	------	34
Gayley	15. Problems of Literary Criticism	3	------	32
Bradley	16. Shakespeare	4	------	9
Syle	17. English Literature of the Eighteenth Century	3	------	3
Gayley	18. Poets of the Nineteenth Century	3	------	31
Gayley	19. The Best English Comedies	3	------	13
Bradley	20. The English Essayists	2	------	5
Lange	21. Advanced Old English: Beowulf	2	------	------
Gayley	27. The History of Æsthetic Consciousness	------	2	19
	GERMAN.			
Putzker; Senger	1. Introductory Course	------	4	120
Putzker	2. Schiller	------	4	76
Senger	3. Scientific German	------	2	16
Senger	4. Goethe	------	3	28
Putzker	5. Lessing	------	3	11
Senger	6. Composition and Conversation	------	2	6
Senger	7. Middle High German and Old High German	2	------	5
Senger	8. Gothic	2	------	3
Putzker	9. German Literature. Graduate Course	------	2½	------
	ROMANCE LANGUAGES.			
Paget; Howard	1. Introductory Course in French. Edgren's French grammar	4	------	132
Paget; Howard	2. Athalie. Le Roi des Montagnes at hearing	4	------	119
Paget; Huntington	3. A Tragedy of Corneille or Racine	3	------	99
Paget; Huntington	4. Two Dramas of Victor Hugo	3	------	96
Huntington	5. French Composition	------	1	8
Paget	6. Victor Hugo's Prose	------	1	30
Huntington	7. Lamartine's Poetry	------	1	12
Paget	10. French Literature in the first half of the Seventeenth Century	------	1	33
Huntington	13. Victor Hugo's Poetry	------	1	8
Paget	15. French Poets and Novelists of the Nineteenth Century	------	1	14
Huntington	17. General Survey of French Literature	-----	1	------
Huntington	1. Spanish Grammar and Selections from Gil Blas	3	------	14
Huntington	2. Modern Spanish Novels	3	------	16
Howard	3. Don Quijote	------	2	9
Huntington	1. Italian Grammar and Modern Italian	------	2	2
Paget	2. Dante: La Divina Commedia	------	2	1
Paget	1. (*a*) Romance Philology: Phonetics and Study of Old Texts	------	2	1
	(*b*) French Literature	1	------	6
Paget	2. Spanish and Italian Literatures	1	------	1
	MATHEMATICS.			
Haskell; Pierce	A. Plane Trigonometry, Analytic Geometry, Algebra	------	5½	56
Stringham; Edwards; Haskell; Pierce; Hengstler	1. Plane Trigonometry	3	------	211
Edwards; Pierce; Hengstler	2. Plane Analytic Geometry	3	------	83
Edwards; Pierce	3. Solid and Spherical Geometry	2	------	62
Edwards; Haskell	4. Spherical Trigonometry	2	------	32
Edwards; Pierce; Hengstler	5. Algebra	4	------	192
Stringham	6. Propædeutic to the Higher Analysis	4	------	12

COURSES OF INSTRUCTION—Continued.

Instructor.	Title of Course.	No. of Hours a Week.		No. Students in Attendance
		One Term	Two Terms	
Stringham	7. Logic of Mathematics	1	------	21
Edwards; Leuschner	8. Differential and Integral Calculus	4	------	52
Edwards; Leuschner	9. Analytic Geometry of Space	4	------	48
Edwards	10. Problems in the Differential and Integral Calculus	2	------	3
Edwards	11. Determinants and Theory of Equations	3	------	4
Haskell	13. Conic Sections: Advanced Course	3	------	4
Leuschner	14. Method of Least Squares	2	------	16
Leuschner	16. Interpolation and the Use of Tables	2	------	4
Edwards	18. Principles and Methods in Instruction	1	------	------
Stringham	19. Theory of Functions of Real Variables	------	2	1
Stringham	20. Differential Equations	3	------	10
Haskell	21. Theory of Algebraic Forms	3	------	2
Haskell	22. Higher Plane Curves	4	------	2
Haskell	25. Theory of Functions of a Complex Variable. Seminary	------	2	3
Stringham	26. Elliptic Functions	------	2½	1
Stringham	29. Partial Differential Equations, Fourier's Series, Spherical Harmonics	2	------	2
Stringham	31. Mathematical Seminary. Alternate Tuesday evenings	------	------	5
	PHYSICS.			
	1. General Physics. Lectures and recitations.			
Slate	(*a*) Heat, Light, Sound, and Electricity	------	3	38
Whiting	(*b*) Principles which underlie measurements in the physical laboratory	------	6	36
Whiting	2. Qualitative Physics	------	6	56
Slate	3. Advanced Physics	------	2	2
Drew	4. Elementary Physical Measurement (*a*)	3	------	21
Drew	Elementary Physical Measurement (*b*)	3	------	8
Drew	Elementary Physical Measurement (*c*)	3	------	1
Raymond	7. Electrical Measurements	4	------	5
Raymond	8. Advanced Physical Measurement	6	------	15
Slate	10. Reading and Discussions	------	6	2
	ASTRONOMY.			
Leuschner	1. Elementary Astronomy	------	3	26
Leuschner	2. Modern Astronomy	3	------	------
Leuschner	3. Supplement to Course 1: Practice in Observing	------	3	13
Leuschner	4. General Astronomy	------	1½	------
Leuschner	5. Practical Astronomy and Navigation —			
	(*a*) Recitation	------	1½	------
	(*b*) Practice in the Observatory	------	4	------
Leuschner	6. History of Astronomy	2	------	------
Leuschner	7. Advanced Practice	------	------	------
Leuschner	8. Theoretical Astronomy	3	------	------
Leuschner	9. Method of Least Squares	2	------	16
Leuschner	10. Interpolation and the Use of Tables	3	------	4
	CHEMISTRY.			
Rising; Sharwood	1. Elementary Chemistry—			
	Course A. Recitations and laboratory demonstrations	4	------	55
	Course B. Recitations and laboratory demonstration	3	------	18
Rising	2. Experimental Lectures on Inorganic Chemistry	------	3	61
Lenher	3. Laboratory: Qualitative Analysis	12	------	64
Rising	4. Laboratory: Quantitative Analysis	12	------	60
Lenher	5. Laboratory: Gravimetric Analysis	18	------	------
O'Neill; Blasdale	6. Laboratory: Volumetric Analysis	18	------	5

COURSES OF INSTRUCTION—Continued.

Instructor.	Title of Course.	No. of Hours a Week. One Term	No. of Hours a Week. Two Terms	No. Students in Attendance
O'Neill	7. Organic Chemistry: Lectures, with experiments	------	2	18
O'Neill; Norris	8. Organic Chemistry: Laboratory. Supplementary to Course 7	18	------	13
Rising	9. Lectures on Theoretical Chemistry	------	2	4
O'Neill	10. Advanced Laboratory	18	------	9
------	12. Selected Topics in Organic Chemistry	1	------	1
Rising; Lenher	13. Electrolysis	1	------	2
Rising; Lenher	15. Analysis of Iron, Steel, and Alloys	1	------	------
O'Neill	16. Physiological Chemistry—			
	(*a*) Lectures	2	------	9
	(*b*) Laboratory practice	3	------	9
O'Neill	19. Water Analysis	1	------	8
	23. Summer School of Chemistry. Six weeks, beginning with May 30, 1894	------	------	11
	Teachers' Course	------	------	1
	BOTANY.			
Howe	1. Vegetal Structure and Morphology	3	------	67
Greene	2. Systematic and Economic Botany	3	------	37
Greene	3. Advanced Systematic Botany	------	3	9
Greene	4. Medical Botany	------	3	------
Howe	5. Cryptogamic Botany	------	3	8
Howe	6. Vegetable Histology	6	------	7
Greene	7. The Phanerogamic Natural Orders	------	5	2
	GEOLOGY.			
Le Conte	1. General Geology	------	3	122
Lawson	2. Field Geology. Alternate Saturdays, both terms	------	------	4
Lawson	3. Petrography	------	1	4
Lawson	4. Petrographical Laboratory	------	3	------
Lawson	5. Graduate Course	------	------	7
	The Bulletin of the Department of Geology, issued from time to time, embodies, in the form of short papers or memoirs, the results of research by some competent investigator. Four numbers of the Bulletin were issued during the year 1893–94. The California Division of the United State Geological Survey has, since October, 1891, made the University its headquarters. A topographical survey of the region around the Bay of San Francisco has been in progress since that time, and a large section of the work has been completed. The results are embodied in contour maps on a scale of two inches to the mile, and contoured in great detail. These will form the basis of a geological map, to be prepared for the Geological Survey under the direction of the Geological Department of the University.			
	ZOÖLOGY.			
Le Conte	1. Comparative Zoölogy	------	2	118
Ritter; Holmes	2. (*a*) Morphology	------	7	17
Ritter; Holmes	(*b*) Morphology of Invertebrates	------	7	13
Ritter; Holmes	4. Structure and Affinities of the Mammalia	9	------	8
Ritter	5. Microscopical Anatomy	9	------	9
Ritter	6. Embryology	9	------	9

Courses of Instruction—Continued.

Instructor.	Title of Course.	No. of Hours a Week.		No. Students in Attendance
		One Term	Two Terms	
Ritter	7. Mammalian Morphology	4	------	22
Ritter	8. Seaside Laboratory. During the summer vacations instruction in animal biology is transferred to the seaside. In 1893 the laboratory was at Avalon, on the Island of Catalina.			
	MINERALOGY.			
Lawson; Ransome	1. Mineralogical Laboratory	------	4	22
Lawson	2. Crystallography, Mineralogical Terminology, and Descriptive Mineralogy	------	2	11
	MECHANICAL ENGINEERING.			
Slate	1. Analytic Mechanics	------	4	22
Hesse	2. Hydrodynamics	3	------	19
Hesse	3. Hydraulics and Hydraulic Machinery	3	------	5
Le Conte	4. Kinematics	------	2	5
Hesse	5. Thermodynamics	3	------	5
Hesse	6. Dynamics of Heat Engines	3	------	5
Hesse; Cory	7. Mechanical Laboratory: Experimental Engineering	------	6	------
Sladky; Le Conte	8. Mechanical Practice	---	6	18
Cory	9. Electrical Engineering—			
	(*a*) Electrolysis and Electro-Metallurgy; Primary and Secondary Batteries	2	------	4
	(*b*) Electro-Magnetism and Dynamo-Electric Machinery	2	------	4
	(*c*) Alternating Currents and Alternating-Current Machinery	2	------	3
	(*d*) Electricity in Engineering and Principles of Electrical Installation	2	-----	4
	(*e*) Electrical Laboratory and Designing	------	6	2
	CIVIL ENGINEERING.			
Randall	1. Surveying	4	-----	20
Randall	2. Railroad Engineering	4	------	5
Randall; Burgess	3. Field Practice and Mapping	------	12	15
Soulé	4. Sanitary Engineering—			
	(*a*) Water supply	4	------	10
	(*b*) Ventilation of Dwellings and Sanitation of Cities	2	------	5
Soulé	5. Strength of Materials	4	------	41
Randall	6. Engineering Structures	4	-----	9
Soulé	7. Engineering Specifications and Contracts	2	------	4
Soulé	8. Irrigation and Drainage	3	------	10
Soulé	9. Theory of Elasticity as applied to Materials of Construction	2	------	------
Randall	10. Highways and Pavements	2	------	------
Soulé	11. Engineering Materials	2	------	4
	MINING, METALLURGY, AND ASSAYING.			
Christy	1. Lectures on Mining	------	4	9
Christy	2. Lectures on Metallurgy	------	3	11
Christy; Booth	3. Assaying. Lectures and Laboratory Practice	------	6	8
Christy; Booth	4. Metallurgical Laboratory	6	------	5
------	5. Ore Dressing	------	2	9
	DRAWING.			
Burgess	1. Elements of Industrial Drawing	------	3	58
Kower	2. Descriptive Geometry	------	3	41
Burgess	3. Topographical and Structural Drawing	------	3	11
Kower	4. Mechanical Drawing	------	6	21

COURSES OF INSTRUCTION—Continued.

Instructor.	Title of Course.	No. of Hours a Week. One Term	No. of Hours a Week. Two Terms	No. Students in Attendance
Kower	5. Graphical Statics	2	------	25
Kower	6. Construction. The designing of engineering structures and machines	------	9	18
Burgess	7. Free-hand Drawing	------	2	11
	AGRICULTURE, HORTICULTURE, AND ENTOMOLOGY.			
Hilgard; Loughridge	1. General Course in Agricultural Chemistry	------	3	9
Hayne	2. Vinification	2	------	-----
Jaffa; Colby	3. Agricultural and Viticultural Laboratory	------	15	11
Wickson	4. General Course in Agriculture and Horticulture	------	3	7
Hayne	5. Viticulture; Olive Culture	2	------	1
Woodworth	7. Elementary and Economic Entomology. Lectures and Practice	4	------	12
Woodworth	8. Apiculture. Lectures and Laboratory Practice	4	------	3
Woodworth	9. Parasitic Plant Diseases	------	3	11
Woodworth	10. Systematic Entomology	3	------	5
Woodworth	12. Entomological Laboratory	------	9	4
	MILITARY SCIENCE AND TACTICS.			
Winn	1. Practical Course: Infantry and artillery exercises, signaling, and band practice	------	2	337
Winn	2. Theoretical Course: Lectures and recitations	------	1	64
	PHYSICAL CULTURE.			
Magee; Selfridge	1. Elementary Course. 5 half-hours, both terms	------	------	175
Magee; Selfridge	2. Advanced Course. 5 half-hours, both terms	------	------	------
Magee	3. Elective Course for Young Women. 5 half-hours, both terms	------	------	------
	THE LIBRARY.			
Rowell	The Use of the Library: A short course of lectures at the opening of the Academic year.			

The following table gives such statistics as are at hand concerning University Courses at the Mark Hopkins Institute of Art, and University Extension Courses:

EXTENSION COURSES.

During the year 1893–94 the following courses were given:

In San Francisco.

(University Courses at the Mark Hopkins Institute of Art.)

First Term.

MATHEMATICS. The Logic of Mathematics: Geometry. Nine lectures by Professor Stringham.

POLITICAL ECONOMY. Introduction to Political Economy. Nine lectures by Assistant Professor Plehn.

ENGLISH. Poets and Dramatists of the Eighteenth Century. Nine lectures by Mr. Syle.

Second Term.

MATHEMATICS. The Logic of Mathematics: Algebra. Nine lectures by Professor Stringham.

LATIN. The Epistles of Horace: Translation and Exegesis. Nine exercises under the direction of Assistant Professor Richardson.

ENGLISH. Poets of the Nineteenth Century. Nine lectures by Mr. Armes.

In Los Angeles.

ENGLISH. The Development of English Comedy. Six lectures by Professor Gayley.

In Sacramento.

POLITICAL ECONOMY. Economics of Industry. Nine lectures by Assistant Professor Plehn.

ENGLISH. The Development of English Comedy. Six lectures by Professor Gayley.

In San Jose.

HISTORY. Napoleon and his Epoch. Six lectures by Associate Professor Bacon.

In Ventura.

POLITICAL ECONOMY. Causes of the Present Social Unrest. Three lectures by Professor Moses.

PHYSICAL CULTURE.

The Instructor in Physical Culture, Mr. Magee, has handed me the following interesting account of the results of the systematic physical training now required of all male students during their first year's residence at the University:

During the past year, there has been in this department, the largest required attendance and the largest voluntary attendance, and the amount of benefit derived has been more satisfactory than in any previous year since its organization.

Physical Culture is compulsory during the first year of attendance at the University, and is subject to the following procedure: First, the physical examination and measurements of the student; second, prescription of work to meet the individual needs.

Each student is examined on entering the University and at the end of the prescribed course; also, in individual cases, at some intermediate point. The examination establishes a record of the name and age of the student, condition of health past and present, nature of diseases which he may have had, accidents, hereditary possibilities, and matters relating to personal hygiene. There are also recorded the weight, six items of height, twenty-seven girths, six breadths, seven lengths, five tests of strength, and lung capacity. The measurement of each student is compared with the average results of measurements made from 15,000 examinations of American college students, and determines how the individual deviates from this standard of the typical or average student.

As a result of the comparison the instructor is enabled to prescribe understandingly for the physical deficiencies of the student. For instance: Should a student have a history of consumption, the fact would be of sufficient importance to prescribe exercise for the thorough development of the chest, and to avoid any exercise which would have a tendency to aggravate the disease; or if the student is found to have other organic trouble, he is advised to take such work on the developing appliances as will meet these conditions. The results obtained seem to thoroughly advocate the wisdom of the methods. If, however, the student has no organic trouble—his muscles being equally distributed, though deficient—he is assigned to general or class work, which consists of setting-up exercises, dumb-bells, bar-bells, chest weights, Indian clubs during the first term, and parallel bars, horse-mat work, and horizontal bar during the second term. The following table shows the results of the past year's work:

1893–94.	Average of 15,000 students of Yale, Amherst, and Cornell.	University of California on entering. Class of '97, 160 students.	University of California, 124 students after 1 year of prescribed work. Class of '97.	Average increase of 124 students, or those who completed the prescribed work. Class of '97.
Weight (in kilogrammes)	61.2	60.7	62.9	2.2
Height (in millimeters)	1,725	1,719.1	1,725.4	6.3
Girths.				
Neck	349	344.8	356.1	11.3
Chest, repose	880	842.7	866.4	23.7
Chest, inflated	927	898.7	960.7	62
Right thigh	517	503.6	519.1	15.5
Left thigh	512	497.1	515.3	18.2
Right calf	359	345.1	352.1	7
Left calf	349	341.6	346.4	4.8
Right upper arm	295	291.6	304.9	13.3
Left upper arm	291	282.7	296.5	13.8
Right forearm	267	262.9	270	7.1
Left forearm	261	258	264.1	6.1
Strength (in kilos).				
Back	137	121	136.8	15.7
Legs	166	184	222	38
Upper arm	80	78.3	120.4	42.1
Forearm	40	41	41.5	.5
Lung capacity (in liters)	3.7	3.6	4.3	.7

Very respectfully submitted,

IRVING STRINGHAM,
Dean.

COURSES OF STUDY IN SECONDARY SCHOOLS.

REPORT OF THE COMMITTEE OF THE CALIFORNIA HIGH SCHOOL CONFERENCE.

In order to procure material for this report, the committee sent a request for courses of study to all the secondary schools in the State. Inclosed was a report blank asking specific questions covering matters of detail and individual opinion not likely to be found in the courses of study. The greatest difficulty has been experienced in securing anything like complete reports. In some instances, after writing again and again, the committee has failed to elicit any response whatever, while in other cases returns were received so late that it was necessary to rewrite entirely a large part of this report. If errors have crept in they may be traced largely to this cause.

In the different tables the varying numbers given for schools represented is due to the fact that some of the Principals left a part of the questions unanswered, or answered them so vaguely that it has been necessary to indicate results in a general way for such schools, or leave them out altogether on the points in question.

There are eighty-two High Schools in the State; seventy-one of these sent reports, and of the seventy-one, fifty-eight sent courses of study also. The thirteen High Schools sending no report and the thirteen sending reports but no courses of study are nearly all small schools, and would probably offer no types which would essentially modify the statistics given. Of the private schools, only those already accredited to the University, or likely soon to become so, were asked for data. Eight out of ten of these institutions have sent reports, and seven have forwarded courses of study.

For purposes of comparison, reports and courses have been asked from a small representative group of Eastern schools, widely scattered and representing the more progressive sections of the Eastern and Middle States.

The order of arrangement of topics has been as follows:

1. High Schools:
    (*a*) Reports;
    (*b*) Courses of Study.
2. Private Secondary Schools:
    (*a*) Reports;
    (*b*) Courses of Study.
3. State Normal Schools:
    Answers to questions 16, 17, 18 of report.
4. Group of Representative Eastern Schools:
    (*a*) Reports;
    (*b*) Courses of Study;
    (*c*) Quotations from Announcements, Courses of Study, and Letters.
5. Summary.

The report blank covered the following questions:

1. Name of school.
2. Location.
3. When organized.
4. Number of teachers engaged in secondary work.
5. Denote each teacher by a letter (to avoid names), and classify by entering the letters on the proper lines below.
   College graduates.
   Normal School graduates.
   Graduates of both Normal School and College.
   Graduates of neither.
   Having taught three years (or more) in secondary schools.
   Having taught less than three years in secondary schools.
   Having experience in Primary and Grammar School work.
6. Number of students in secondary school-work: Boys, —; girls, —.
7. Number in last graduating class: Boys, —; girls, —.
8. From last two graduating classes, number that have attended some institution of higher learning: Boys, —; girls, —.
9. Number of months per year that your school is in session.
10. Average length of your recitation periods, — minutes. Note any marked exceptions.
11. Requirements for admission to your school, when preliminary examination is given.
12. Number of years of school-work preparatory to your school.
13. Do you graduate students who pursue an irregular course on the same footing with those who are regular?
14. What subjects are optional for your students?
15. What fraction of the time assigned to the subject is given to laboratory work in Physics? in Chemistry?
16. Underscore subjects in the following list, which, in your judgment, should have a place in the programmes of secondary schools: Botany, Zoölogy, Geology, Astronomy, Plane Trigonometry, Advanced Algebra, Political Economy, Business Course (so called).
17. Would you begin secondary school work in mathematics with Algebra or with Elementary Concrete Geometry?
18. Do you consider it best to begin secondary science work with easy generalization over the science of common things, and specialize afterwards into the various branches of the subject; or would you first take up separately the special subjects, and generalize later?

1. HIGH SCHOOLS.

(*a*) Reports—(71 schools).

(1) *Organization*—69 reporting.

Dates from 1855 to 1893, with 48 schools in 1891–2–3; four of the latter, however, are cases of reorganization.

(2) *Teachers:*

13 schools have one teacher each; 24 schools have two teachers each; 34 schools have more than two teachers each.

Of the 44 schools started in the years 1891–2–3—

11 schools have one teacher each; 22 schools have two teachers each; 11 schools have more than two teachers each.

Several of these newly organized schools have not full classes in operation, so have not yet their full teaching force.

Total number of teachers	274
College graduates	63 per cent.
Normal School graduates	21 per cent.
Graduates of both Normal School and College (previously counted under both heads)	7 per cent.
Graduates of neither	23 per cent.
Graduates of either Normal School or College	77 per cent.
Having taught three or more years in secondary schools	74 per cent.
Having taught less than three years in secondary schools	26 per cent.
Having experience in Primary and Grammar School work	74 per cent.

The object of the form of the question was to try to discover what number of Normal graduates in a measure made up by experience for lack of training.

(3) *Pupils:*

(*a*) Enrolled:

Boys	3,014; or 41 per cent.
Girls	4,359; or 59 per cent.
Total	7,373

Average to each teacher, 28+.

NOTE.—One half of total number are in the cities of San Francisco, Alameda, Sacramento, Stockton, Fresno, and San José. The schools having more than two teachers show an average of thirty pupils to the teacher. More exactly, they have 6,028 pupils and 204 teachers. In Los Angeles and Oakland the ratio is 1 teacher to 29 pupils; Sacramento, 1 to 30; San Francisco, 1 to 41.

(*b*) Last Graduating Class:

Boys	357; or 39 per cent of total number graduating.
Girls	548; or 61 per cent of total number graduating.
Total	905

NOTE.—Many of the schools were organized so recently that they have not yet been able to send out full classes. Twenty-three did not graduate any pupils last year.

(*c*) From last two graduating classes, number that have attended some institution of higher learning:

Boys	284; or 56 per cent of total below.
Girls	221; or 44 per cent of total below.
Total	505

Assuming that one half of these were from last year's class, 40 per cent of the boys and 20 per cent of the girls, or 28 per cent of pupils graduating, attended some institution of higher learning. Again:

Schools reporting 2,449 boys and 3,673 girls, or a total of 6,122 pupils in attendance, would give 1,084 boys and 1,633 girls graduating in three and four years, according to their respective courses of study, and on the assumption that they would average each year the same number of graduates as in 1893. Actual figures would exceed this estimate. From these figures we get—

44 per cent of the boys in attendance graduate;
44 per cent of the girls in attendance graduate;
or 44 per cent of the pupils graduate.

Now, since 40 per cent of the boys and 20 per cent of the girls graduating attend higher institutions, it may be shown that from the High Schools—

18 per cent of the boys in attendance go higher after graduating, and
9 per cent of the girls do the same;
or, 12 per cent of the total number of pupils enrolled go to higher institutions.

(4) *Recitation Periods:*

(*a*) Average	41 minutes.

(*b*) By the number of teachers—

Schools of 1 teacher, average period	34 minutes.
Schools of 2 teachers, average period	41 minutes.
Schools of 3 teachers, average period	43 minutes.
Schools of 4 teachers, average period	44 minutes.
Schools of 5 teachers, average period	43 minutes.
Schools of 6 teachers, average period	45 minutes.
Schools of 7 teachers, average period	46 minutes.
Schools of 8 teachers, average period	42½ minutes.
Schools of 14 teachers, average period	45 minutes.
Schools of 23 teachers, average period	45 minutes.
Schools of 24 teachers, average period	55 minutes.

Whilst it is true that there is a gradual increase in length of period with increased number of teachers, this may be more than counterbalanced by the smallness of the classes in the schools having only one or two teachers.

(5) *Marked Exceptions to Average Recitation Period:*

In favor of—

Physics and Chemistry	11 schools.
English	3 schools.
History	1 school.
Mathematics	4 schools.
Latin	1 school.

Against—

English	2 schools.
Commercial Law	1 school.
Commercial Arithmetic	1 school.
Physical Geography	1 school.
Zoölogy	1 school.

And a few subjects, on account of smallness of classes.

(6) *Requirements for Admission:*

The usual grammar grade studies	67 schools.
Same as requirements for Eighth Grade	1 school.
Proof of ability to carry the work; no definite requirements	3 schools.

(7) *Number of Years Preparatory to High School:*

Seven years	2 schools.
Eight years	36 schools.
Nine years	26 schools.
Ten years	2 schools.
No report	5 schools.

Average, 8.4 years.

(8) *Number of months to the year:*

Ten and one half months	1 school.
Ten months	45 schools.
Nine and three fourths months	1 school.
Nine and one half months	4 schools.
Nine months	19 schools.
No report	1 school.

Average, 9.7 months (4 weeks each).

NOTE.—There is an element of uncertainty here, because some of the schools reporting ten months really have 42 weeks, if holidays and Institute week are counted, as is usually done.

(9) *Question 13 of Report:*

No	53 schools.
Yes	15 schools.

(10) *Question 14 of Report:*

Everything optional if approved by Principal	3 schools.
Everything optional except English	1 school.
Everything optional except one year English	1 school.
Everything optional except minimum Mathematics	1 school.
No options except in courses	26 schools.

In others, options mostly between Languages and Sciences.

(11) *Question 15 of Report:*

(*a*) For Physics, ranges from none to all, with an average of $\frac{49}{100}$. 62 schools have laboratory work.

(*b*) For Chemistry, ranges from none to all, with an average of $\frac{53}{100}$. All but one having the subject have laboratory work.

(12) *Question 16 of Report:*

Botany	58 schools.
Zoölogy	45 schools.
Geology	30 schools.
Astronomy	29 schools.
Plane Trigonometry	39 schools.
Advanced Algebra	25 schools.
Political Economy	43 schools.
Business Course	27 schools.

(13) *Question 17 of Report:*

Algebra	34 schools.
Elementary Concrete Geometry	31 schools.
Both together	2 schools.
Elementary Geometry should be in Grammar Schools	6 schools.

(14) *Question 18 of Report:*

In favor of generalization first	26 schools.
In favor of specialization first	40 schools.
No report or non-committal	5 schools.

NOTE.—These figures cannot, however, be considered as settling anything very definitely, for there is evidence in many reports that the writer did not get the meaning intended by the question.

(15) *Specific recommendations* were given in several cases, often quite contradictory in character.

One Principal writes: "The friends of education have admitted to the course of study subjects that do not belong in the secondary schools, simply because, without them, the number of pupils would be greatly reduced and strong opposition to the schools would be developed. I am certain that this High School can be sure of support in no other way. For this reason I approved a 'Business Course.'"

Another says: "Political Economy, all ought to study. Its fundamental principles are easily understood and provide an effective safeguard against the nostrums of some of our financial reformers. No 'Business Course' or other nonsense."

Then comes another, who says: "We must not lose sight of the fact that our secondary schools are not, and never will be, rightly, preparatory schools."

A fourth does not quite agree, for he says: "A High School will fail or accomplish little in a community if it allows its work to be considered final. Its main work is to stimulate to higher courses."

A fifth agrees with the last, but he is working under difficulties which many will appreciate. He says: "I wish to inspire pupils with a desire for university education. My board is not with me in this."

One of the Principals would substitute Botany for Chemistry, on the ground that it is the more inductive science. He says: "Absolutely nothing is presupposed in Botany, while much is presupposed in Chemistry."

(*b*) Courses of Study—High Schools.

Thirty-nine High Schools have a three-years' course, nineteen have one covering four years, while the courses of two schools are so arranged that they may be completed in either three or four years, according to the mental energy of the student. These three- or four-year schools are counted in the four-year class. Most California High Schools are twelve-year schools. The exceptions are mostly toward eleven, though one or two have thirteen years, all told. The twelve years, as an average, seem to be divided practically into eight and one half years for the work of the elementary school and three and one half years for that of the secondary school.

Only fifty-eight High Schools sent courses of study, and some of these are so indefinite in details that it has been difficult to specify quantity and time for given subjects. The statistics gleaned from the various courses have been arranged under the heads: "What?" "When?" "How Long?"

What? Fifty-eight schools.

Mathematics—

Algebra	58 schools.
Plane Geometry	58 schools.
Solid Geometry	32 schools.
Arithmetic	32 schools.
Plane Trigonometry	25 schools.
Elementary Concrete Geometry	13 schools.
Elementary Algebra	7 schools.
Advanced Algebra	5 schools.
Spherical Trigonometry	1 school.
Analytical Geometry and Surveying	1 school.

Science—

Physics	58 schools.
Chemistry	54 schools.
Botany	40 schools.
Zoölogy	28 schools.
Physical Geography	30 schools.
Astronomy	22 schools.
Physiology	17 schools.
Geology	13 schools.
Natural History	2 schools.

History and Political Science—

Civil Government	52 schools.
Ancient History	51 schools.
Mediæval History	49 schools.
United States History	16 schools.
Political Economy	15 schools.
General History	9 schools.
English History	7 schools.
Comparative Government	1 school.

English—

Literature (probably biographical and historical)	10 schools.
Technical English Grammar	18 schools.
Rhetoric	38 schools.
Thackeray's Newcomes	27 schools.
Classic Myths (or equivalent)	32 schools.
Burke's Orations (or equivalent)	32 schools.
Julius Cæsar	29 schools.
Merchant of Venice	27 schools.
Milton's Comus	20 schools.
Evangeline	11 schools.
Snow-Bound	20 schools.
Hales' Longer English Poems (or equivalent)	26 schools.
Vision of Sir Launfal	23 schools.
English composition (as a text)	9 schools.
Irving's Alhambra	26 schools.

What? English—Continued.

Lady of the Lake	18 schools.
Lay of the Last Minstrel	9 schools.
Sir Roger de Coverly	24 schools.
Some 28 classics, less than	5 schools.

NOTE.—So many schools reported "English" without specifying, that the above is not at all a full representation. In general, in accordance with the requirements of the State University, the schools all have the subjects and classics outlined above, with a few substitutions of options.

Latin	54 schools.
Greek	18 schools.
Modern Languages—	
French	12 schools.
German	27 schools.
Spanish	4 schools.
Miscellaneous—	
Bookkeeping	28 schools.
Drawing	19 schools.
Commercial Law	14 schools.

And 19 other subjects, from Mining to Agriculture, and from Psychology to Elocution, are presented by one or two schools each.

When?

Mathematics—

Elementary Geometry	First year	11 schools.
	Second year	2 schools.
Elementary Algebra	First year	7 schools.
Algebra	First year	48 schools.
	Second year	8 schools.
	Third year	2 schools.
Plane Geometry	First year	7 schools.
	Second year	34 schools.
	Third year	17 schools.
Solid Geometry	Second year	2 schools.
	Third year	15 schools.
	Fourth year	15 schools.
Plane Trigonometry	Third year	12 schools.
	Fourth year	13 schools.
Advanced Algebra	Third year	3 schools.
	Fourth year	2 schools.
Arithmetic	First year	17 schools.
	Second year	11 schools.
	Third year	2 schools.
	Fourth year	2 schools.

Science—

Physics	First year	5 schools.
	Second year	26 schools.
	Third year	23 schools.
	Fourth year	4 schools.

When? Science—Continued.

Chemistry	First year	3 schools.
	Second year	12 schools.
	Third year	27 schools.
	Fourth year	12 schools.
Botany	First year	26 schools.
	Second year	9 schools.
	Third year	4 schools.
	Fourth year	1 school.
Physical Geography	First year	18 schools.
	Second year	5 schools.
	Third year	7 schools.
Zoölogy	First year	12 schools.
	Second year	10 schools.
	Third year	4 schools.
	Fourth year	2 schools.
Astronomy	First year	2 schools.
	Second year	2 schools.
	Third year	13 schools.
	Fourth year	5 schools.
Physiology	First year	9 schools.
	Second year	6 schools.
	Third year	1 school.
	Fourth year	1 school.
Geology	First year	1 school.
	Second year	1 school.
	Third year	7 schools.
	Fourth year	4 schools.

History and Political Science—

Ancient History	First year	33 schools.
	Second year	17 schools.
	Third year	1 school.
Mediæval and Modern History	First year	27 schools.
	Second year	19 schools.
	Third year	3 schools.
General History	First year	8 schools.
	Second year	1 school.
English History	First year	1 school.
	Second year	1 school.
	Third year	5 schools.
History of United States	First year	7 schools.
	Third year	4 schools.
	Fourth year	5 schools.
Civil Government	First year	10 schools.
	Second year	2 schools.
	Third year	27 schools.
	Fourth year	13 schools.
Political Economy	Second year	3 schools.
	Third year	2 schools.
	Fourth year	10 schools.

When?—Continued.

English. (See note under "What.")

Literature	First year	2 schools.
	Second year	4 schools.
	Third year	2 schools.
	Fourth year	2 schools.
Technical English Grammar	First year	11 schools.
	Second year	5 schools.
	Third year	2 schools.
The Newcomes	First year	2 schools.
	Second year	6 schools.
	Third year	15 schools.
	Fourth year	4 schools.
Classic Myths (or equivalent)	First year	19 schools.
	Second year	10 schools.
	Third year	3 schools.
Burke's Orations (or equivalent)	Second year	1 school.
	Third year	20 schools.
	Fourth year	11 schools.
Rhetoric	First year	22 schools.
	Second year	10 schools.
	Third year	4 schools.
	Fourth year	2 schools.
Julius Cæsar	First year	1 school.
	Second year	15 schools.
	Third year	11 schools.
	Fourth year	2 schools.
Milton's Comus	First year	1 school.
	Second year	5 schools.
	Third year	11 schools.
	Fourth year	3 schools.
Evangeline	First year	10 schools.
	Second year	1 school.
Snow-Bound	First year	16 schools.
	Second year	3 schools.
	Third year	1 school.
Hales' Longer English Poems, or Syle's From Milton to Tennyson	Second year	9 schools.
	Third year	13 schools.
	Fourth year	4 schools.
Vision of Sir Launfal	First year	8 schools.
	Second year	10 schools.
	Third year	5 schools.
Merchant of Venice	First year	4 schools.
	Second year	16 schools.
	Third year	6 schools.
	Fourth year	1 school.
English Composition	First year	8 schools.
	Second year	1 school.
Alhambra	First year	18 schools.
	Second year	7 schools.
	Third year	1 school.

When? English—Continued.

Lady of the Lake	First year	15 schools.
	Second year	2 schools.
	Third year	1 school.
Sir Roger de Coverly	First year	8 schools.
	Second year	12 schools.
	Third year	4 schools.
Lay of the Last Minstrel	First year	4 schools.
	Second year	4 schools.
	Third year	1 school.

Languages:

Greek	First year	1 school.
	Second year	12 schools.
	Third year	5 schools.
Latin	First year	49 schools.
	Second year	5 schools.
French	First year	5 schools.
	Second year	4 schools.
	Third year	3 schools.
German	First year	13 schools.
	Second year	6 schools.
	Third year	8 schools.

In making the above table, it was impracticable to segregate into three- and four-year groups, so the figures can be taken as indicating when a subject is begun, counting from the beginning of the course; it may or may not be completed in the same year. If the figures of the third year are taken as indicating that a subject is commenced in the next to the last year, it must be borne in mind that there are chances in favor of its being the last instead, on account of the large number of three-year schools.

A year covering five recitation periods a week has been used as the unit of time in the following table:

How Long? In every case the maximum is taken.

English. Total average, 3.3 years.

2½ years	4 schools.
3 years	35 schools.
3½ years	2 schools.
4 years	15 schools.
5 years	2 schools.

Mathematics. Total average, 3.21 years.

Algebra—

1 year	15 schools.
1½ years	37 schools.
2 years	6 schools.

Average, 1.42 years.

Plane Geometry—

1 year	39 schools.
1½ years	16 schools.
2 years	3 schools.

Average, 1.19 years.

How Long? Mathematics—Continued.

Solid Geometry—

½ year	32 schools.

Average, ½ year.

Plane Trigonometry—

½ year	24 schools.
1 year	1 school.

Average, .52 year.

Arithmetic—

¼ year	2 schools.
½ year	23 schools.
1 year	6 schools.
2 years	1 school.

Average, .6 year.

Science. Total average, 3.2 years.

Physics—

1 year	50 schools.
1½ years	6 schools.
2 years	1 school.
2½ years	1 school.

Average, 1.09 years.

Chemistry—

¼ year	2 schools.
½ year	8 schools.
1 year	43 schools.
1½ years	1 school.

Average, .85 year.

Physical Geography—

¼ year	2 schools.
½ year	23 schools.
1 year	5 schools.

Average, .57 year.

Botany—

¼ year	1 school.
½ year	24 schools.
1 year	15 schools.

Average, .68 year.

Zoölogy—

¼ year	3 schools.
½ year	18 schools.
1 year	7 schools.

Average, .60 year.

Physiology—

¼ year	2 schools.
½ year	13 schools.
1 year	2 schools.

Average, .53 year.

Astronomy—

¼ year	3 schools.
½ year	16 schools.
1 year	3 schools.

Average, .53 year.

How Long? Science—Continued.

Geology—

¼ year	3 schools.
½ year	9 schools.
1 year	1 school.

Average, .47 year.

History and Political Science. Total average, 2.64 years.

History—

1 year	5 schools.
1½ years	10 schools.
2 years	24 schools.
2½ years	11 schools.
3 years	6 schools.
3½ years	2 schools.

Average, 2.08 years.

Science of Government—

¼ year	2 schools.
½ year	39 schools.
1 year	10 schools.
1½ years	1 school.

Average, .66 year.

Political Economy—

¼ year	3 schools.
½ year	11 schools.
1 year	1 school.

Average, .48 year.

Languages.

Latin—

2 years	2 schools.
3 years	40 schools.
4 years	12 schools.

Average, 3.19 years.

Greek—

1 year	1 school.
2 years	13 schools.
2½ years	2 schools.
3 years	2 schools.

Average, 2.11 years.

French—

2 years	8 schools.
3 years	3 schools.
4 years	1 school.

Average, 2.42 years.

German—

2 years	19 schools.
3 years	7 schools.
4 years	1 school.

Average, 2.33 years.

2. PRIVATE SECONDARY SCHOOLS.

(*a*) Reports—(8 schools).

(1) Organization. From 1866 to 1894.

(2) Teachers:

(*a*) Total	40
(*b*) College graduates	83 per cent.
(*c*) Normal School graduates	8 per cent.
(*d*) Graduates of both Normal School and College	5 per cent.
(*e*) Graduates of neither Normal School nor College	15 per cent.
(*f*) Graduates of either Normal School or College	85 per cent.
(*g*) Having taught three or more years in secondary schools	83 per cent.
(*h*) Having taught less than three years in secondary schools	17 per cent.
(*i*) Having experience in Primary and Grammar School work	78 per cent.

(3) Pupils:

(*a*) Boys enrolled	271
(*b*) Girls enrolled	1
(*c*) Average to teacher	8

Note.—It must be borne in mind here that all of the teachers are counted for full time, when, as a matter of fact, many of them devote but a part of the day to the school. Full time being counted, it is doubtful if so small a number of pupils to the teacher would appear.

(*d*) Last graduating class	56 per cent.
(*e*) From last two graduating classes, attending institutions of higher learning	69 per cent.

Assuming that one half of these were from last year's class, and taking into consideration only those schools which send complete reports, it is found that 67 per cent of the pupils graduating from private secondary schools afterward attended some higher institution. On the basis of four classes like those of 1893, 74 per cent of the total attendance will graduate. We then get 50 per cent as the part of the total attendance afterward going to college.

(4) Average length of school year	9.87 months.
(5) Average recitation period	40 minutes.

(6) Requirements for admission: Equivalent to the requirements of public schools for Grammar School diplomas.

(7) Question 13 of report: All answered "No."

(8) Question 14 of report: Options mostly in languages or courses.

(9) Question 15 of Report:

Physics	Average, $\frac{1}{2}$
Chemistry	Average, $\frac{3}{5}$

(10) Question 16 of Report (8 schools voting):

Botany	6 schools.
Geology	2 schools.
Plane Trigonometry	7 schools.
Business Course	4 schools.

(10) Question 16 of Report—Continued.

Zoölogy	4 schools.
Astronomy	1 school.
Political Economy	3 schools.
Advanced Algebra	4 schools.

(11) Question 17 of Report:

Algebra	4 schools.
Elementary Geometry	2 schools.
Both	2 schools.

(12) Question 18 of Report:

Easy generalizations first	4 schools.
Special subjects first	2 schools.
No report	2 schools.

(*b*) COURSES OF STUDY—(7 schools).

Of the seven schools sending programmes, five have four years in their courses and two have three years. So few schools are represented in this list that the statistics will be consolidated as much as possible.

(1) English. Total average time, 3.5 years.
  Division of the subject practically as in the High Schools.

(2) Mathematics. Total average time, 3.53 years.
  Algebra, 6 schools: all first year; average time, $1\frac{2}{3}$ years.
  Plane Geometry, 6 schools: first year, 2; second year, 2; third year, 2; average time, $1\frac{1}{6}$ years.
  Solid Geometry, 5 schools: third year, 2; fourth year, 3; average time, $\frac{1}{2}$ year.
  Arithmetic, 5 schools: all first year; average time, $\frac{4}{5}$ year.
  Trigonometry, 5 schools: third year, 1; fourth year, 4; average time, $\frac{1}{2}$ year.

NOTE.—One school gives time for Mathematics without specifying further.

(3) Science—(7 schools reporting). Total average time, 2.9 years.
  Physics, 7 schools: first year, 1; second year, 3; third year, 1; fourth year, 2; average time, 1 year.
  Chemistry, 7 schools: first year, 2; third year, 2; fourth year, 3; average time, 1 year.
  Astronomy, 1 school: fourth year; average time, $\frac{1}{4}$ year.
  Physical Geography, 3 schools: first year, 2; second year, 1; average time, $\frac{2}{3}$ year.
  Physiology, 4 schools: all first year; average time, $\frac{3}{4}$ year.
  Botany, 3 schools: all third year; average time, $\frac{5}{6}$ year.
  Zoölogy, 2 schools: first year, 1; third year, 1; average time, $\frac{1}{2}$ year.

(4) History and Political Science. Total average time, 2.8 years.
  Ancient History, 7 schools: first year, 2; second year, 3; fourth year, 2; average time, .96 year.
  Mediæval and Modern History, 6 schools: second year, 1; third year, 2; fourth year, 3; average time, .92 year.
  United States History, 5 schools: first year, 3; second year, 1; average time, .62 year.
  Civil Government, 6 schools: first year, 1; third year, 4; fourth year, 1; average time, .58 year.
  English History, 4 schools: first year, 1; second year, 3; average time, .75 year.

(5) Languages—
Latin, 7 schools; total average time, 3.6 years.
Greek, 6 schools; total average time, 2.42 years.
French, 4 schools; total average time, 2.13 years.
German, 4 schools; total average time, 2 years.

3. CALIFORNIA STATE NORMAL SCHOOLS. (3 schools.)

(*a*) Question 16 of Report:

Botany	2 schools.
Zoölogy	2 schools.
Geology	2 schools.
Astronomy (as an option with Geology)	1 school.
Plane Trigonometry	1 school.
Advanced Algebra	1 school.
Political Economy	2 schools.

(*b*) Question 17 of Report:

Algebra	none.
Elementary Concrete Geometry	3 schools.

(*c*) Question 18 of Report:

Specialization first	2 schools.
Generalization first	1 school.

4. GROUP OF REPRESENTATIVE EASTERN SCHOOLS.

(*a*) Reports.

(1) Organization:

	Date.
Roxbury Latin School, Roxbury, Mass.	1645
Phillips Exeter Academy, New Hampshire	1783
English High School, Boston	1821
Providence, R. I., High School, Classical Department	1843
English High School, Cambridge, Mass.	1847
Central High School, Grand Rapids, Mich.	1858
Central High School, Kansas City, Mo.	1868
Denver High School	1874
North Division High School, Chicago	1878
Washington, D. C., High School	1882
Hughes High School, Cincinnati	1885

(2) Teachers (11 schools):

Total number	283
College graduates	57 per cent.
Normal School graduates	19 per cent.
Graduates of both (counted in both)	6 per cent.
Graduates of neither	29 per cent.
Graduates of either Normal School or College	71 per cent.
Having taught three or more years in secondary schools	80 per cent.
Having taught less than three years in secondary schools	20 per cent.
Having experience in Primary and Grammar School work	39 per cent.

(3) Pupils:

Total attendance	8,118
Average to each teacher	29—

On the basis of four classes like those of last year—High Schools only—

54 per cent of those in attendance will graduate.
22 per cent of those graduating will go higher.
12 per cent of those in attendance will go higher.

Leaving out schools which have only boys, and keeping separate account of the sexes, we have—

37 per cent of total attendance are boys.
63 per cent of total attendance are girls.
33 per cent of the graduates are boys.
67 per cent of the graduates are girls.
62 per cent of those going higher are boys.
38 per cent of those going higher are girls.

Leaving out Exeter and Roxbury, and taking only High Schools—

35 per cent of the boys graduating go higher.
12 per cent of the girls graduating go higher.
52 per cent of the boys in attendance graduate.
56 per cent of the girls in attendance graduate.
18 per cent of the boys in attendance go to higher institutions.
7 per cent of the girls in attendance go to higher institutions.

(4) Average length of school year .... 9.8 months.

(5) Average length of recitation period .... 49 minutes.

(6) Question 11 of Report:
Equivalent of California Grammar Grade Diploma.

(7) Number of years preparatory 8.2

(8) Question 13 of Report:
No, 9; Yes, 2.

(9) Question 14 of Report:
As a rule, options are in courses rather than in subjects.

(10) Question 15 of Report:

Physics	54 per cent.
Chemistry	61 per cent.

(11) Question 16 of Report (11 schools voting):

Botany	10 schools.
Zoölogy	8 schools.
Geology	7 schools.
Astronomy	6 schools.
Plane Trigonometry	8 schools.
Advanced Algebra	8 schools.
Political Economy	8 schools.
Business Course	8 schools.

(12) Question 17 of Report:

In favor of Algebra first	5 schools.
(But of these, 4 would have Elementary Concrete Geometry in Grammar School.)	
In favor of beginning with Elementary Concrete Geometry in High Schools	3 schools.
In favor of carrying the two parallel	2 schools.
Both begun below	1 school.

(13) Question 18 of Report:

Beginning with easy generalizations	4 schools.
Beginning with special subjects	6 schools.
No report	1 school.

(*b*) COURSES OF STUDY—(9 schools; all 4 years).

(Cambridge and Cincinnati did not send courses.)

- Mathematics, 9 schools; total average time, 3.34 years.
  - Arithmetic, 6 schools: first year, 4; second year, 1; third year, 1; average time, .63 year.
  - Algebra, 9 schools: first year, 8; second year, 1; average time, 1.16 years.
  - Elementary Geometry, 2 schools: first year; average time, .7 year.
  - Plane Geometry, 9 schools: first year, 1; second year, 5; third year, 3; average time, 1.03 years.
  - Advanced Algebra, 5 schools: third year, 1; fourth year, 4; average time, .6 year.
  - Plane Trigonometry, 8 schools: third year, 2; fourth year, 6; average time, .4 year.
  - Solid Geometry, 6 schools; third year, 2; fourth year, 4; average time, .38 year.
  - Analytical Geometry, 3 schools: fourth year; average time, .38 year.
  - Surveying, 1 school: third year; average time, .5 year.
  - Spherical Trigonometry, 1 school: fourth year; average time, .5 year.
- Science, 8 schools; total average time, 3.88 years. (A classical department is dropped.)
  - Physics, 8 schools: second year, 4; third year, 3; fourth year, 1; average time, .91 year.
  - Chemistry, 8 schools: second year, 1; third year, 5; fourth year, 2; average time, .85 year.
  - Astronomy, 4 schools: fourth year; average time, .42 year.
  - Botany, 4 schools: first year, 3; third year, 1; average time, .65 year.
  - Zoölogy, 5 schools: first year, 3; second year, 2; average time, .73 year.
  - Physiology, 3 schools: first year, 1; second year, 2; average time, .51 year.
  - Physical Geography, 1 school: second year; average time, .5 year.
  - Geology, 5 schools: all fourth year; average time, .66 year.
  - Biology, 2 schools: first year, 1; second year, 1; average time, .65 year.
  - Psychology, 3 schools: fourth year; average time, .44 year.
  - Mineralogy, 1 school: third year; average time, .5 year.
- English, 9 schools; total average time, 2.51 years.
  - Not specific in printed course, 3 schools.
  - Grammar, 3 schools: first year.
  - Rhetoric, 6 schools: first year, 4; second year, 1; fourth year, 1.
  - English Composition, 4 schools: first year, 2; second year, 1; fourth year, 1.
  - History English Literature, 3 schools: fourth year.
  - Various classics, 6 schools.

History and Political Science, 9 schools; total average time, 2.05 years.
- Ancient History, 8 schools: first year, 3; second year, 3; third year, 2; total average time, .63 year.
- Mediæval and Modern History, 3 schools: second year, 2; fourth year, 1; total average time, .78 year.
- English History, 6 schools: first year, 3; second year, 1; third year, 1; fourth year, 1; average time, .45 year.
- General History, 3 schools: first year, 1; third year, 2; average time, .93 year.
- United States History, 3 schools: first year, 2; fourth year, 1; average time, .44 year.
- Political Economy, 5 schools: third year, 2; fourth year, 3; average time, .55 year.

Languages:
- Latin—all 8 have 4 years; Roxbury has 6 (2 below).
- Greek, 7 schools; average time, 2.78 years.
- French, 8 schools; average time, 3.14 years.
- German, 9 schools; average time, 3.55 years.
- Spanish, 2 schools; average time, 4 years.

Miscellaneous:
- Bookkeeping, 6 schools.
- Music, 6 schools.
- Drawing (usually mechanical), 8 schools.
- Commercial Law, 3 schools.
- Phonography, 2 schools.
- Commercial Geography, 2 schools.
- And a few other subjects, 1 school each.

(*c*) QUOTATIONS FROM ANNOUNCEMENTS, COURSES, ETC.

"While the studies pursued do prepare pupils to enter college, yet the High School is not a mere college preparatory school, for all the essential features of a practical education are fully provided. As far as possible the system is elective, so that a pupil will not be obliged to devote his time to studies for which he has no aptitude or taste."—*Grand Rapids, Mich., High School.*

"No one is allowed to take all the studies offered, but each is required to make, subject to the approval of the Faculty, such a combination of studies as best suits his needs. No one is allowed to begin Latin and Greek the same year. A minimum of sixteen hours a week each year constitutes a satisfactory course. The regular studies of the first year are Latin, six hours; Mathematics, five hours; English, three hours; and History of the United States and England, two hours. These studies are required of all. In general, four years of Latin, Mathematics, and English, three of Greek, two of History, and one of Physics and French or German, satisfy the ordinary requirements for admission to college."—*Phillips Exeter Academy.*

"Notice to Parents.—The school session begins at 8:30 A. M. and closes at 1 P. M. It is divided into six 45-minute periods, known as the recitation hours. Only two of these can be used by a student in preparing his lessons at school; and to complete the work of the High School creditably in four years requires consistent, careful, and conscientious effort upon the part of the student. Therefore, his time for study should not be encroached upon by social amusements or business occupation."—*Kansas City High School.*

In twenty-two years Kansas City High School graduated 860 pupils, of whom 28 per cent were boys and 72 per cent girls.

"The general course will consist of three studies, full time, five recitations a week, for four years, besides Drawing and Vocal Music; of which studies, one Foreign Language, Algebra, Plane Geometry, two Sciences, and two full years of English will be required."—*Courses of Study for Chicago High Schools.*

"English comprehends Declamation, Composition, and the reading and study of authors. Selections from standard authors are studied critically with the teacher. Supplementary to this, works of standard authors are prescribed for pupils to read by themselves. From these works subjects, from time to time, are drawn, upon which pupils are required to write compositions, the writing going on under the eye of the teacher."—*English High School, Boston.*

Prof. Chas. B. Scott, of the Conference on Natural History, chosen by the Committee of Ten, writes:

"I have very decided ideas in regard to Question 18. My own experience leads me to believe that High School pupils need very much the habits and the powers which come from genuine individual laboratory work in science, and that the sooner such careful study, by the laboratory method, of some one science is taken up in the school the better it is for the pupils. The 'easy generalizations' confirm wrong habits of study or absorption and give the pupils very little power. By all means take up as early as possible some one subject and study it thoroughly."

Mr. Wm. C. Collar, Head Master of Roxbury Latin School, and a member of one of the Committee of Ten Conferences, writes:

"I have always wished, and do not cease to, that other schools would do what I do—put the number of hours against each study and give a statement of what is actually accomplished."

5. SUMMARY AND GENERAL CONSIDERATIONS.

(*a*) COMPARISON OF SPECIAL POINTS IN THE REPORTS FROM THE THREE GROUPS OF SCHOOLS.

(1) Teachers:	Cal. H. S.	Cal. Priv. S.	East. Group.
College graduates	63%	83%	57%
Normal School graduates	21%	8%	19%
Graduates of both	7%	5%	6%
Graduates of neither	23%	15%	29%
Graduates of either	77%	85%	71%
Three or more years' secondary experience	74%	83%	80%
Less than three years' secondary experience	26%	17%	20%
Having Primary and Grammar experience	74%	78%	39%

(2) Pupils:	Cal. H. S.	Cal. Priv. S.	East. Group.
Average to each teacher	28+	8	29—
Of total attendance	Boys, 41% Girls, 59%	All Boys.	Boys, 37% Girls, 63%
Of the graduates	Boys, 39% Girls, 61%	-------	Boys, 33% Girls, 67%
Of those going higher, there are	Boys, 56% Girls, 44%	Boys' Schools.	Boys, 62% Girls, 38%
Of boys graduating, there go higher	40%	----	35%
Of girls graduating, there go higher	20%	----	12%
Of pupils graduating, there go higher	28%	67%	22%
Of boys in attendance, there graduate	44%	----	52%
Of girls in attendance, there graduate	44%	----	56%
Of pupils in attendance, there graduate	44%	74%	54%
Of boys in attendance, there go higher after graduating	18%	----	18%
Of girls in attendance, there go higher after graduating	9%	----	7%
Of pupils in attendance, there go higher after graduating	12%	50%	12%
(3) Average length of school year	9.8 mos.	9.8 mos.	9.7 mos.
(4) Average length of recitation period	41 min.	40 min.	49 min.
(5) Average length of preparatory course	8.4 yrs.	-------	8.2 yrs.

(6) As previously noted in the Eastern schools, options are rather in courses than in subjects. This is true, to a great extent, in California also, with the exception of those High Schools which make everything optional conditioned with the approval of the Principal, or with a reservation in favor of English or Mathematics. A small group of these schools have a somewhat distinctive character. In the English High School, Boston, the number of electives is gradually increased from year to year, until the work of the last is almost all elective.

	Cal. H. S.	Cal. Priv. S.	East. Group.
(7) Fraction of time allotted to Physics devoted to laboratory work	49%	50%	54%
Fraction of time allotted to Chemistry devoted to laboratory work	53%	60%	61%

(8) In all the reports East and West, Botany has the largest number of votes as having a place on the programme of secondary schools. Granting Physics and Chemistry, then, as already very generally conceded subjects, a third science would seem to be Botany. Political Economy, of another group of subjects, received a large number of votes. The High Schools of California seem to be disposed to leave out Advanced Algebra altogether.

(9) The vote on Question 17 seems to indicate very little preference between Elementary Algebra and Concrete Geometry as a beginning study in secondary Mathematics. The general opinion appears to be that both subjects properly belong in the Grammar School.

(10) In answer to Question 18, the vote East and West, with the exception of the California private schools, is in favor of early specialization with later generalization. It may be noticed, however, that those who seem best to understand the force of the question vote in favor of easy generalization in the elementary school, with later specialization.

(*b*) COURSES OF STUDY.

The principal points of difference noted between the East and West as to what is pursued, is in our favor with reference to the study of English classics with us, rather than biography of authors and formal rhetoric, with less average time on classics as shown by the Eastern courses.

The points of difference are against us on Latin, Greek, Solid Geometry, and Plane Trigonometry. As to the length of time devoted to the various subjects:

	Cal. H. S.	Cal. Priv. S.	East. Group.
English	3.30 yrs.	3.50 yrs.	2.51 yrs.
Mathematics	3.21 yrs.	3.53 yrs.	3.34 yrs.
Algebra	1.42 yrs.	1.66 yrs.	1.16 yrs.
Plane Geometry	1.19 yrs.	1.16 yrs.	1.03 yrs.
Solid Geometry	.50 yr.	.50 yr.	.38 yr.
Plane Trigonometry	.52 yr.	.50 yr.	.40 yr.
Science	3.20 yrs.	2.76 yrs.	3.88 yrs.
Physics	1.09 yrs.	1.00 yr.	.85 yr.
Botany	.68 yr.	.83 yr.	.65 yr.
Chemistry	.85 yr.	1.00 yr.	.85 yr.
History and Political Science	2.64 yrs.	2.76 yrs.	2.05 yrs.
Latin	3.19 yrs.	3.60 yrs.	4 (Rox.6)
Greek	2.11 yrs.	2.42 yrs.	2.78 yrs.
French	2.42 yrs.	2.12 yrs.	3.14 yrs.
German	2.33 yrs.	2.00 yrs.	3.55 yrs.

In the East a larger proportion of schools have Advanced Algebra, but the average time for the ordinary presentation of the subject of Algebra is less than with us; this would indicate either that we do more thorough work or that we devote too much time to this study.

Building up a course of study out of the time allotments given above, we have:

Eastern Group.		California High Schools.
2.51 yrs.	English	3.30 yrs.
3.34 yrs.	Mathematics	3.21 yrs.
2.05 yrs.	History and Political Science	2.64 yrs.
3.88 yrs.	Science	3.20 yrs.
11.78 yrs.	Total	12.35 yrs.

These figures make a somewhat stronger showing for the California High Schools in the ordinary English course. However, if we add four years of Latin to the Eastern total, and 3.19 to that for California, we have 15.78 for the Eastern group and 15.54 for our schools. If we leave out Science and put in Greek, the totals become 14.68 for the East and 14.45 for California.

(*c*) The committee has felt that it would rather not make any recommendations, and therefore has confined its labors to the arrangement of the material in shape to be discussed by the Conference. However, the following arrangement and distribution of time is offered merely as a bare outline as a basis for discussion:

Languages—English and others	6 yrs.
Mathematics	3 yrs.
History and Political Science	3 yrs.
Natural Science	4 yrs.
Total	16 yrs.

The year adopted as the unit consists of five recitations per week for one year. The subjects to be taken four at a time for four years. The committee has not been disposed to criticise, but it feels that a word ought to be said with reference to one point: Many of the smaller and weaker schools are starting out with three courses of study, sometimes embracing Greek, when they would do better to confine their energies to a single course and make the work in it as thorough as possible.

W. F. HALL,
T. L. HEATON,
FREDERICK SLATE,
Committee.

REPORT OF THE DIRECTOR OF THE LICK OBSERVATORY.

Lick Observatory, University of California,
September 1, 1894.

To the President of the University of California:

Dear Sir: I have the honor to submit to you my seventh annual report as Director of the Lick Observatory.

The Regents have established a special set of regulations for the government of the Lick Observatory, to which I beg to call your attention. These are printed in the report of the Secretary of the University for 1888, page 26. Every important official action is recorded in our letter-books, or in a regularly kept journal.

The Senior classes in astronomy in various California colleges have been specially invited to visit the Observatory on special evenings set apart for them. Similar privileges have been granted to various conventions meeting in San Francisco and San José. Lectures have been given by the Astronomers in various places.

The Astronomical Society of the Pacific (which now numbers about five hundred members) holds its summer meetings at Mount Hamilton. The Director has replied to hundreds of letters of inquiry on astronomical subjects addressed to the Observatory, and has furnished telegrams, etc., on subjects of general interest, to the press.

The time-service is maintained as before, and the noon-signal from the Observatory reaches nearly every railway station between San Francisco and Ogden, San Francisco and Portland, and San Francisco and El Paso. In these and other ways the Lick Observatory is made directly useful to the public; and it cannot fail to have an important part in the intellectual advancement of the State and of the whole country.

In a few months the Lick Observatory will be able to offer quarters to intending students, and it is likely that the list of students will be materially larger during the next year.

Nearly all of the buildings of the Lick Observatory are in excellent condition inside and out. All the work upon them during the past year has been done by our own workmen, except some repairs to the rolling gear of the large dome.

The honorary degree of Doctor of Science has been bestowed on Professor Barnard by the University of Nashville. He had previously received (on my nomination) the honorary degree of M.A. from the University of the Pacific. Dr. Barnard was awarded the Lalande medal of the Paris Academy of Sciences in December, 1892, and in November, 1893, the Arago medal of the same Academy for his discovery of a fifth satellite to Jupiter.

The honorary degree of M.S. was conferred upon Professor Schaeberle in June, 1893, by the University of Michigan.

On Commencement Day of 1893 the University of California conferred the honorary degree of Doctor of Science upon Professor L. Weinek, Ph.D., Director of the Observatory of Prague, and upon Professor J. E. Keeler, B.A., Director of the Allegheny Observatory. Some of the work of these gentlemen is printed in Volume III of the Publications of the Lick Observatory.

It is quite impossible to give an adequate account of the astronomical work of so active an establishment as the Lick Observatory without taking more space than is available in a report like the present one. I beg, therefore, to refer you to the list of publications* made by the astronomers during the period September 1, 1893, to September 1, 1894, which is annexed hereto, calling your special attention to Professor Schaeberle's discussion of the observations of the solar eclipse of 1893, and to his discovery of a comet on the eclipse negatives; to Professor Barnard's remarkable photographs of the comet *c*, 1893, and of Gale's comet, and to his long series of observations of the fifth satellite of Jupiter (which are now being calculated for a determination of the orbit by Professor Pritchett); to the spectroscopic observations of Professor Campbell, especially those on the spectra of Mars, of the bright-line stars, of the nebulæ, and to his discovery of a star with a measurable diameter; to Mr. Tucker's long series of meridian circle observations; to the important series of sun-spot photographs taken by Mr. Perrine, and to the observations of the August meteors of 1894 by Messrs. Schaeberle, Colton, and Perrine at Mount Diablo and at Mount Hamilton, respectively. Over seven hundred meteors were timed and mapped by the Mount Hamilton observers. Volume III of the Publications of the Lick Observatory contains the work on the moon negatives taken here by myself, and enlarged by Professor Weinek.

A full report of the solar eclipse of April, 1893, will soon be sent to the printer. Professor Schaeberle has been engaged upon this discussion since his return from the expedition in July, 1893. The photographs secured by him are by far the best yet taken.

It is hoped that arrangements can be made to send Professor Campbell to Japan to observe the solar eclipse of August, 1896, spectroscopically. He will need one assistant to aid in the photographic work.

The meridian circle has been employed by Mr. Tucker during the past year, mainly in the observation of a list of one hundred and twenty-five stars selected by Professor Holden from the *American Ephemeris*, *Connaissance de Temps*, and *Nautical Almanac*. These are stars not included in the Berlin *Jahrbuch*, and are to be reduced with stars from the last named work as standard. Four observations have been made of each star in one position of the instrument, and will be repeated in the reversed position. Six hundred observations have been made of the stars of the Berlin *Jahrbuch*, selected by Professor Auwers, in the belt from —10° to +15° declination, to serve as fundamentals, and four hundred and fifty observations of the circumpolar stars of the same work. The places of various short lists of comparison stars have been determined; and with the observations made for special investigations, and for clock corrections, on a few nights other than those used for regular observing, two thousand three hundred observations have been made during the year.

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*The full list of publications, in all departments of the University, is reserved for a succeeding report.

Professor Schaeberle observed a large number of stars at Ann Arbor before 1888, but no reductions had been made when he came to the Lick Observatory. It was agreed that this work should be reduced and printed here, as the star-places would be valuable. Mr. Leuschner in 1888 and 1889 spent an hour a day for about a year in transcribing the observations from the original note-books on to the reduction sheets. Professor Campbell also assisted in this work. The sheets were then sent to three computers in the East, and the work was proceeded with until $860 had been paid for it. This sum was derived from two gifts to the Lick Observatory: (1) from Miss Bruce of New York, $500 (received in October, 1890); (2) from the U. S. Coast and Geodetic Survey, $360 (received in October, 1891, and in February, 1892). A great part of the more mechanical work was done in this way. When the sheets were returned to the Lick Observatory the work was continued by Mr. Tucker under the direction of Professor Schaeberle. The Observatory is under engagement to complete and publish this work, and this should be done promptly. It will fill one of the quarto volumes of our Publications.

Astronomers have refraction-tables which represent observations at the level of the sea. Among the best of these are the tables made at Pulkowa. If similar tables are made at the Lick Observatory, at an altitude of 4,200 feet, the needs of astronomers, in this direction, will be provided for. It is obviously a duty of the Lick Observatory to provide such tables. Accordingly, I agreed with Professor Schaeberle in 1889 on a programme of observations, and he has secured the number required. They are, however, mostly unreduced. One of the first Publications of the Lick Observatory should be devoted to this work.

I brought to California in 1886 the manuscript of a catalogue of 38,000 stars from the Washington zones, on which I had then completed 80 or 85 per cent of the work. I have not been able to do anything further with it since that time. The services of a computer for six or eight months are required to complete it. It will fill two of the quarto volumes of the Observatory Publications.

By direction of the Regents I have prepared a short and popular account of the Lick Observatory for free distribution. The pamphlet contains thirty-two pages, and is stereotyped. The first edition (printed in August, 1894) consists of one thousand copies.

The very liberal policy of the Lick Observatory with respect to visitors has made us many friends in all parts of the world. About 40,000 persons have visited the Observatory since June 1, 1888. I have noticed, with great pleasure, that it is very generally understood that the Lick Observatory stands ready to answer any and all questions relating to astronomy, so far as it is able, and our correspondence of this sort is large, and is increasing. It sometimes requires more time than can readily be spared, but I am satisfied that such time is well spent. When any unusual event occurs, like the appearance of the brilliant meteor of July 27, 1894, we receive unsolicited reports from a large number of intelligent correspondents throughout the State, which are very valuable to us, and which show, at the same time, a useful relation between the Observatory and the public. The Astronomical Society of the Pacific, through its meetings and through its publications, is an important factor in such relations. The officers of the Observatory have regularly transmitted to the newspapers popular accounts of interesting results attained here. Each of these reports, short or long, expresses the facts in each case precisely as they are; and I think we may say that these reports, which are obviously sober-minded and entirely reliable, have done much to establish the relation of trust and respect between the Observatory and the public, which we feel is a source of strength, and which aids us in our work.

With the aid of an appropriation from the Santa Clara County Board of World's Fair Commissioners an exhibit of transparencies and photographic prints was prepared for exhibition at Chicago in the Santa Clara County space of the California Building. At the Midwinter Fair this exhibit was displayed in the Santa Clara County Building. The Regents of the University directed that the Observatory prepare a second exhibit, to be displayed at the Midwinter Fair in the space allotted to the University of California. This second exhibit is somewhat fuller than the exhibit at Chicago, as many new negatives have been obtained since June, 1892, when the first exhibit was completed. The chief features of both these exhibits are framed glass transparencies of astronomical and other negatives made by the astronomers of the Observatory, and also enlargements from these negatives made either at Mount Hamilton, or by foreign astronomers and experts. Each picture bears a label which gives the necessary information regarding it. Copies of many of these negatives can be purchased from the leading photographers of San Francisco and San José. Attention is particularly directed to photographs of the solar coronas of January, 1889, December, 1889, and April, 1893, by Messrs. Burnham, Schaeberle, and Barnard; to photographs of the moon, in the focus of the large telescope, taken by various astronomers; to the very successful enlargements of these negatives made by Baron Rothschild, of Vienna, Professor Weinek, Director of the Observatory of Prague, Victor Nielson, of Copenhagen, and by Mr. Colton of the Lick Observatory (these enlargements are of various scales, from the moon's diameter equal ten feet, downward); to photographs of the milky way and comets, by Professor Barnard; to star maps in both the northern and southern hemispheres; to photographs of nebulæ, and especially to pictures of the total solar eclipse of April, 1893, by Professor Schaeberle; to photographs of drawings of Mars and of comets, by Professor Hussey; to spectrum photographs and drawings, by Professor Campbell; to photographs (enlarged) of Jupiter, taken with the large telescope; to photographs of the sun and sun-spots, taken by Mr. Perrine, and to views of the Lick Observatory, its instruments and its surroundings, taken by all the astronomers.

The total money outlay for the improvement of Mr. Lick's tomb has been $755 23. Of this, $445 80 was paid by the Lick Trustees, and $309 43 has been made a charge against the annual budget of the Lick Observatory for the years 1894–5.

Two cottages designed as quarters for Messrs. Barnard and Campbell have been nearly completed during the year.

The attic is the only dangerous part of the main building of the Lick Observatory with respect to fire. There are now two hydrants in it, each provided with hose. At some future time the advice of a competent architect should be taken on plans to make this more safe from fire, and it will be worth while, I think, to expend considerable money in making the necessary changes. We cannot afford to run any risks in this respect.

The large dome has worked well in every respect, except that the wheels of the live-ring have on three occasions worked loose and left the tracks. The Lick Observatory Committee authorized the purchase of an inside guard-rail, which was put on in August, 1894. I believe the dome is now entirely safe. It is carefully inspected once a week.

At some future time I wish to bring to your attention the desirability of constructing a gallery around the outside of the large dome some twenty feet above the ground. The cost will not be great; it was a part of the original plan; it will materially improve the looks of the building; and it will be very useful to the observers.

At the present time the storage-capacity of the reservoirs is as follows: (1) Huyghens reservoir: 65,000 gallons; 31 feet below the observatory level; it is used to hold the rain water which comes from the roofs of the Lick Observatory, and of the brick house. A windmill here lifts the water to Copernicus 205.4 feet higher. (2) There is a small catchment (safety) reservoir of 1,000 gallons under the east porch of the Lick Observatory. (3) Copernicus reservoir: capacity of the brick reservoir, 35,000 gallons; of four wooden tanks on the same level, 16,000 gallons; total, 51,000 gallons; 174.4 feet above the Observatory; supplied by the windmill pump at Huyghens; the water of Copernicus reservoir supplies the power to the water-engines and rams of the great dome. The water in Huyghens and Copernicus reservoirs is not fit for household uses, as it is covered with oil from the machinery in the dome. (4) Aquarius reservoir (at the springs): capacity of the main reservoir, about 27,000 gallons; of the smaller adjacent reservoir, about 9,000 gallons; of five small wooden tanks, 10,000 gallons; of three larger wooden tanks, 10,000 gallons; total storage capacity, 56,000 gallons; this reservoir is 365.5 feet below the level of the Observatory, and 411.5 feet below the level of Kepler reservoir, which it supplies by means of a steam pump (and by means of a Pelton wheel in the winter time when there is a great deal of overflow-water). (5) Kepler reservoir: two brick reservoirs of 85,000 gallons capacity each.

The water supply from the springs varies greatly between summer and winter, between wet and dry seasons. In the rainy winter of 1889–90 the daily supply was about 22,000 gallons, or over 600,000 gallons per month. The smallest daily supply, towards the end of the dry season, is from 400 to 500 gallons (the daily expenditure of water by the Lick Observatory and dwelling-houses has been about 1,500 gallons). During the months of May or June to November we must depend largely on stored spring water for use. During the months of November to May there is a great waste of water at the springs. We are obliged to let it overflow, for there is no suitable place to construct a reservoir near the springs, and it is not even safe to place more wooden tanks near them, on account of the shifting nature of the soil. It is possible that a small reservoir of some 20,000 gallons can be constructed a short distance up the road (near a little spring which is now utilized as a part of our supply), and a trial of this will be made as soon as practicable. If necessary, another reservoir can be built at Kepler, but the ground (loose soil) is not favorable. It is probable, therefore, that the supply of spring water for the Lick Observatory must be limited by the capacity of the present reservoirs, say 170,000 gallons at Kepler and about 56,000 gallons at Aquarius. It then becomes very important to economize the use of this water, and there are several ways in which this can be done.

The mean annual rainfall at the Lick Observatory is 32.99 inches; 20 inches is probably an absolute minimum. At present 18,576 square feet of roof surface is arranged to catch the rainfall and to lead it to reservoirs. The average rain supply is then 388,000 gallons (and the minimum, 232,000 gallons). By including more roof surface the average supply can easily be brought up to 400,000 gallons. We can store of this supply only 116,000 gallons at present (Huyghens, 65,000; Copernicus, 51,000), and we therefore waste annually at least 284,000 gallons, for lack of storage. It therefore seems to be of the first importance to construct somewhere south of the large dome (and on a level some 30 feet lower) as large a storage reservoir for rain water as possible. A large part of the bricks for such a reservoir are now on hand, and it could be constructed mainly by the labor of the Observatory workmen. This water could be kept clean and entirely fit for domestic uses at the new brick cottages and at the old wooden cottages and the stables. The cottages would then use spring water (from Kepler) for drinking and cooking, etc., only, and would prefer the clear rain water for other uses. Whatever rain water was so used would be saved in the expenditure from Kepler. The new rain water reservoir would then, in effect, be the same as increased storage capacity of spring water at Kepler. It would also serve as an admirable and efficient fire protection to all the cottages. I beg to recommend this suggestion most strongly to your attention.

We have lately fitted some of the offices and rooms of the Observatory with steam coils, formerly used in the South Hall at Berkeley, connecting them with the steam engine employed to drive the dynamo. In this way it is possible to heat these offices and rooms without being subjected to the intolerable smoke which has been endured, more or less patiently, for six years. (See Publ. A. S. P., Vol. II, page 63.) The cost to the Observatory has been *nil*. The coils had been rejected at Berkeley, and the Lick Observatory workmen have done all the steam-fitting. It is hoped that this system may be still further extended.

The electric light and storage battery plant, which was the gift of the Edison Company, was put in order and started in October last, by Mr. Babcock from the San Francisco office. The battery has been constantly in use since that time, displacing the old chromate batteries which furnished a comparison spark for the spectroscope, and to illuminate the *mire* of the meridian circle. The capacity of the battery is small (the full charge would only light ten 16-candle lamps for four hours), so that it is seldom used for general lighting, but is a great convenience for the two uses named, and in time may be used to displace some of the other batteries for general work. The Observatory and offices are equipped with circuits and lamps, and a larger storage capacity would permit the use of more of this safe light. Windmills appear to be successfully used for driving dynamos. As strong winds prevail here, this would be an excellent source of power, and could probably be made to furnish light for all uses.

I earnestly urge upon your attention the planting of trees on the "reservation." We now know what trees will thrive here, thanks to experiments by the Agricultural Department of the University and by ourselves. If the Lick Trustees had proceeded in this respect, we should already have a situation much better suited for astronomical observation, and far more sightly to the eye. If a Forestry Station were to be established here its expenses would be small, and its results would be valuable to the State at large, and particularly so to the Observatory. To establish such a station requires a simple authorization from the Regents. I understand that Dr. Hilgard is in favor of this extension of his work.

The following important gifts have been received by the Lick Observatory:

From the Smithsonian Institution, through the Secretary, Dr. S. P. Langley, $50, for fitting a special quick shutter to the large telescope, to be used in making enlarged photographs of portions of the sun's surface. The shutter was loaned to the Observatory by Dr. Langley.

The third installment of $1,000 was received from Mrs. Hearst for the first half of the year 1893. (Received January 3, 1894.)

Mr. Walter W. Law gave an additional sum, $270, to complete the illustrations of the Moon for Volume III of the Publications of the Lick Observatory.

The Royal Society of London generously presented the Observatory with its *Philosophical Transactions* for the years 1872–1886 (making our set complete), and with its *Proceedings*, Volumes 33–44. Many other gifts of books are acknowledged in the report of the Secretary of the University, but the gift of the Royal Society deserves a special acknowledgment.

Gifts of books, etc., to our library are regularly acknowledged in the reports of the Secretary of the University. They are very numerous and valuable. We receive the publications of all the principal observatories in the world and of a great number of academies of science (including those of Paris, London, Berlin, Dublin, Vienna, Munich, Rome, etc.), as well as generous gifts of special memoirs from scientific men all over the world. In return for such gifts the publications of the Observatory are distributed as far as the editions are sufficient. A list of all books and photographs sent out is kept at the Lick Observatory.

The total money gifts to the Lick Observatory since 1888 have been nearly $10,000.

The forest fires of 1891 have been spoken of in the Publications A. S. P., Vol. III, page 292, and Vol. V, page 109. These fires burned around a semi-circle from north (through east) to south; they were never nearer than 4,000 feet to the Observatory; and they were confined by our work and otherwise to the farther slopes of the mountains round about.

Some time on July 28 or 29, 1894, a fire started in a deep cañon to the west of the Observatory and to the north of the brick-yard. Its smoke was very obvious all day Sunday, July 29th. On Monday the Observatory workmen, with one volunteer, cut a narrow trail from a point above the fire down to the trout stream in the bottom of Cañon Negro, which lies north and northeast of the Observatory peak. This trail was between the forest fire and the Observatory, and beyond the the trail back fires were set to widen the line of protection. On Tuesday morning Mr. Macdonald, machinist of the Lick Observatory, went twice over this line from its beginning to the trout stream (some 1,500 feet below the summit), and found no place in which the forest fire had crossed our back fires. At noon on Tuesday, however, the fire had crossed the line, and was making great progress towards the Observatory, and especially towards the wooden cottages near the Observatory and the wooden stables and sheds. Fortunately, a considerable space below these buildings along the road to the springs (Aquarius) had been cleared of trees and brush in 1891. This space was once more quickly cleared off, and a line of back fires set along the Aquarius road. More men were sent for, and during Tuesday and Wednesday (day and night) there were some forty persons employed in fighting the fire (including all the astronomers of the Lick Observatory). About two miles of back fires were set and controlled. No damage whatever was done to any of the wooden cottages, to the stables, to the house of the United States Coast and Geodetic Survey, to the water tanks, to the engine and pump houses at the springs. These were protected by our labor. The buildings of the Lick Observatory were certainly at no time in danger. It is probable that we rather underestimate than overestimate the risk from such fires as these. Unless the winds are very high* (say, 30 miles per hour and upwards), it seems easy to control a forest fire of which one has sufficient warning. With high winds carrying large sparks, it is almost impossible to defend long lines or large areas. In such cases the wise course is to defend buildings and their immediate surroundings, and let the rest go. At the worst, we only lose a few hundred acres of chaparral, which renews itself within a few years. In one respect the present fire was vastly easier to manage than those of 1891. It was so near to the buildings that the water supply of the Lick Observatory could be and was utilized. After using all that was necessary, there remained in Copernicus reservoir 15,000 gallons; in Kepler reservoir, 122,000 gallons; in Huyghens reservoir, about 50,000 gallons, and a good supply at the springs. We become so used to the changed conditions of life at Mount Hamilton, that it does not strike us as strange to see members of the University faculty in the role of firemen, not to say salamanders. To realize the incongruity, it is necessary to shift the scene, and to imagine the fire to be in Greenwich Park, or at Enckeplatz, S. W., Berlin. Efficiency is a virtue, wherever it is found, and the astronomers of the Lick Observatory may justly claim to be efficient in the theory and practice of fighting forest fires.

There are many other topics of which it would be perfectly appropriate to speak in a report like the present, but which I have omitted in order to keep within reasonable limits of space.

The "Notices from the Lick Observatory," regularly printed in the Publications A. S. P., give the history of the institution in a permanent form and allow its progress to be traced from month to month.

I trust I may be allowed, as in some manner the spokesman for my colleagues, to express our sense of the generous support which the Observatory has received from the Regents during its whole history. I feel sure that I have a right to say, also, that no work has been spared on our part to make the best use of the opportunities which have been afforded us.

Respectfully submitted.

EDWARD S. HOLDEN,
Director of the Lick Observatory.

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*The highest velocity of the wind Tuesday was 15 miles per hour, at 11 P. M.; the highest of Wednesday was 20 miles, from 3 to 8 A. M. and from 5 P. M. to 12 P. M.

REPORT OF THE SAN FRANCISCO ART ASSOCIATION.

(MARK HOPKINS INSTITUTE OF ART.)

To President MARTIN KELLOGG, *University of California:*

DEAR SIR: The Art Association was formally placed in possession of the Institute on the third day of March, 1893, and the School of Design opened its first session in the building on the first day of May, 1893, with fifty-four (54) students, which number increased to ninety-six (96) at the close of the school year, May 15, 1894, this being the full number the rooms occupied by the school could accommodate. In fact, a number of applicants could not be taken for want of sufficient room.

The Board of Directors brought this fact to the attention of Mr. Edward F. Searles, through his legal representatives, and Mr. Searles, with his unlimited generosity, signified his willingness to remodel the stable building into suitable quarters for school purposes. This work has been accomplished, and the students now occupy the new building. Our facilities are now so largely increased that, at least, two hundred students can be accommodated, and new classes in wood-carving, illustration, architecture, etc., will be added in the near future. A class in modeling has already been established.

On the evening of May 25, 1894, the annual exhibition of works of the students was held, and the regular prizes distributed, Miss Pauline Schoenmaker being awarded the "Avery medal" for general excellence in oil painting; Mr. G. Piazzoni, the "Alvord medal" for best drawing from the antique, and Mr. J. M. Raphael, the "W. E. Brown medal" for best drawing from life. The studies exhibited showed a steady improvement in the quality of the work of the students over that of previous years.

Students are registered from British Columbia, many of the Pacific Coast States, and from all parts of California.

Many graduates of the school are now finishing their art education in Paris and Munich, and they have taken as high positions in the fine-art schools abroad as students from any of the art schools in the United States.

With our new school building, with its perfect system of lighting and special arrangements for art-school purposes, our facilities for art instruction equal, if they do not surpass, those of any school of its character in America, and should enable the school to take even a higher position than heretofore.

Respectfully,

J. R. MARTIN,
Assistant Secretary.

REPORT OF DEAN OF HASTINGS COLLEGE OF THE LAW.

San Francisco, October 23, 1894.

To Dr. Martin Kellogg, *President of the University:*

Dear Sir: The Hastings College of the Law, constituting the Law Department of the University, is in a fairly flourishing condition. The number of students has increased from 140 in the year 1893–94, to 156 in the year 1894–95. Larger and more suitable lecture-rooms will, in all probability, soon be necessary. The present rooms were never designed for lecture purposes, and besides they are becoming too small to comfortably accommodate the increasing attendance. It is to be hoped that the State can see its way clear in the near future, to give this department and the other departments of the University in San Francisco, relief in the way of a University building. The growth of the college, and modern methods of instruction in the law, have rendered the employment of an additional instructor almost imperative at this time. Our present needs are, therefore, new quarters and an increased teaching force.

Very respectfully,

CHARLES W. SLACK,
Dean Hastings College of the Law.

REPORT OF THE DEAN OF THE MEDICAL DEPARTMENT

San Francisco, October 8, 1894.

To the President of the University:

Dear Sir: I have the honor of making the following report of the progress and needs of the Medical Department of the University.

In order to conform to the custom of the academic departments of the University and of Eastern medical colleges, the Faculty has determined to change the plan, heretofore pursued, of conducting a spring and summer session. The session of 1895 will begin January 7th and continue six months. Thereafter the sessions will begin September 1st and continue eight calendar months.

Recognizing the necessity of adequate preliminary training, the Faculty now requires of all matriculants the presentation of credentials equivalent to a diploma from an accredited High School or the passing of an examination embracing subjects of a High School course.

During the past year the course of instruction has been extended to four years. Four full years of medical study are required of all candidates for the degree of Doctor of Medicine, except graduates of accredited literary or scientific colleges and those who have spent two years in attendance upon the Natural Science course of the University, or some other recognized institution.

Notwithstanding the greatly increased requirements, both for matriculation and graduation, there has been a gratifying increase in the number of students in attendance, the total enrollment during the past session being 135.

The Faculty labors under one serious disadvantage. The building now occupied, the gift of the late Dr. H. H. Toland, has become unfit for the teaching of modern medicine. Repairs are so frequently required that the funds are largely used for this purpose alone, preventing the Faculty from making improvements that are sadly needed. Besides this, since the college was founded, the growth of the city has been such that the building is far removed from the business and residence centers. The students bitterly complain of the loss of time necessitated by the great distance separating the college from the City and County Hospital, where their clinical work is done.

From the sale of a portion of the land originally deeded to the University by Dr. Toland, a lot has been purchased directly opposite the City and County Hospital. For many years the Faculty has sought to obtain an appropriation from the State Legislature for the purpose of erecting a suitable building upon this lot. At the last session of the Legislature the hopes of the Faculty were raised by the almost unanimous passage of a bill appropriating $250,000 for a building for all the affiliated departments of the University. It was felt that from the establishment of such an institution the University could enter upon a new and broader path of prosperity. Its influence upon the *esprit de* *corps* of the Faculties of the various affiliated colleges, upon the University as a whole, and upon the public at large, could not be overestimated. Unfortunately, such large appropriations had been made for other purposes, that the Governor did not see his way clear to approve the bill.

The Faculty earnestly hopes that the Board of Regents will appreciate its efforts to raise the standard of medical education and will join with the Faculty in an endeavor to obtain the needed appropriation from the State Legislature at its forthcoming session.

Respectfully submitted.

R. A. McLEAN,
Dean.

REPORT OF THE SECRETARY OF THE SAN FRANCISCO POLYCLINIC.

(POST-GRADUATE MEDICAL DEPARTMENT OF THE UNIVERSITY OF CALIFORNIA.)

San Francisco, October 8, 1894.

To the President of the University:

Dear Sir: By articles of affiliation the San Francisco Polyclinic became in May, 1892, the Post-Graduate Medical Department of the University of California. The Polyclinic had, even before that, been giving instruction by practical and demonstrative methods to graduates of colleges of regular medicine; but its students had been few, as the institution, with meager facilities and in unsuitable quarters, was directly competing for patronage with the well-established, well-equipped, and well-managed schools of the East. Since the affiliation the conditions have, up to the past few months, remained unchanged.

In June of this year the institution moved into a building of its own adapted to its special work and built for it by its friends. The building contains seven clinic rooms for the dispensary work, a large lecture room, a bacteriological laboratory, waiting rooms, reading rooms, and a drug store.

The finances of the Polyclinic are in a satisfactory condition. As a teaching institution it is but just beginning its career.

HARRY M. SHERMAN,
Secretary Board of Trustees San Francisco Polyclinic.

REPORT OF THE DEAN OF THE COLLEGE OF DENTISTRY.

SAN FRANCISCO, November 20, 1894.

To MARTIN KELLOGG, A.M., LL.D., *President of the University of California:*

DEAR SIR: I have the honor of making the following report of the Department of Dentistry.

Since our last report, the predictions then made have been quite fulfilled. In order to prepare for an increased attendance, we were obliged to enlarge the premises occupied by the College of Dentistry in the Donohoe building. This involved a lease of the entire sixth floor, and an increase in the seating capacity of the lecture room and the department of manual training in the infirmary. We are now well equipped and enabled to accommodate two hundred students without crowding.

The opening of the thirteenth session bids fair to test our facilities to the utmost, as the enrollment has been beyond anything in the history of the school.

There is a marked improvement in the material presented, which is no doubt due to our advanced standard of entrance requirements.

With the twelfth session we inaugurated the plan of paying monthly salaries to our instructing staff, who are elected annually by the Faculty. The results prove the wisdom of the plan. Not only is the attendance more constant, but the character of service has been improved.

The policy of the Faculty has been to devote almost the entire income to educational purposes, which has resulted in our having, probably, the best equipped dental college in the country, and a department of which the mother university may well be proud.

The work has been arduous for the governing Faculty, who are all actively engaged in private practice, but who still devote many hours each week to the work of the school without reward, other than a grateful professional appreciation.

The income of the department now diverted to payment of rents and Sunday services would, with future surplus over necessary expenditures, enable us to pay fixed salaries to professors in each department if the professional colleges of the University could be housed by the State in some central location. We could thus secure and maintain, for each chair, the best talent that the country afforded, and round out the usefulness of the University of California.

We need a closer relationship with the academic department, which can only be secured by a standard of entrance requirements for the professional schools, established and supervised by those in authority. When this is done our students will be true sons and daughters of the University, and our graduates will be eligible to membership in its Association of Alumni.

Yours respectfully,

L. L. DUNBAR,
Dean.

REPORT OF THE DEAN OF THE COLLEGE OF PHARMACY.

San Francisco, November 1, 1894.

To President Martin Kellogg, *University of California:*

Sir: The work of the College of Pharmacy for the year 1894 is now virtually concluded, and I am able to report to you upon the results, as well as upon its needs in view of the year's experiences.

The total number of students was 110, of whom 71 were in the Junior and 39 in the Senior class. Of the Juniors, only 49 presented themselves at the final examination, and of these, probably one third will fail to obtain sufficient credits to entitle them to enter the Senior class next term.

Among the causes which have contributed to this unsatisfactory result, I may mention the raising of the standard required, and the lack of general education on the part of some students. The Trustees and Faculty have recently taken steps to remedy the latter evil by raising the requirements for entrance at the next term, with the expectation that in a few years they will be able to demand a high school education as a condition of matriculation.

The same causes will doubtless result in the graduating of a smaller percentage than usual of the Senior class. The course of instruction is being extended almost yearly, especially in the line of practical work, our aim being to keep this college in the very front rank among the Colleges of Pharmacy on this continent.

The expenses are met entirely from the fees received for tuition. The cost of maintaining the building (alterations, repairs, taxes, insurance, interest on mortgage), with gas, water, fuel, etc., added to the necessary apparatus, chemicals, specimens, etc., leaves but a very small sum available as compensation to the Faculty, with nothing whatever for enlargement. It has now become necessary for us to have two additional laboratories (one for pharmaceutical chemistry and the other for microscopy and pharmacognosy), to secure which a new building would have to be built. But we have no funds for such a purpose. Had we such a building as we ought to have, our teaching facilities and the standing which our college has attained among the sisterhood of Colleges of Pharmacy would attract to this State many who now seek their pharmaceutical education elsewhere. It is not to the interest of the State that these young people are allowed to go away, when such a small outlay would bring them here. Had the bill which the last Legislature passed, providing for a building in San Francisco to accommodate the Colleges of Law, Medicine, Dentistry, and Pharmacy, become a law, these students would add to the number of those now receiving their instruction here, and we should at the same time be better equipped for imparting the knowledge which is now communicated under some disadvantages.

I am, sir, very respectfully,

W. M. SEARBY,
Dean.

PUBLISHED WRITINGS OF NEW MEMBERS OF THE FACULTY.

THOS. P. BAILEY., Jr., Ph.D., Assistant Professor of the Science and Art of Teaching.

1. The development of character (inaugural thesis, Columbia, S. C., 1891).
2. Review of translation from Herbart. *Pedagogical Seminary*, Feb., 1893.
3. Humanity of the Spiritual Life. *Christian Thought*, Oct., 1892.
4. Ejective Philosophy. *Am. Journal of Psychology*, Aug., 1893.
5. Psychology for Teachers. *Proceedings South Carolina State Teachers' Association*, 1893.
6. Herbart and Education for Character. *Southern Educational Journal*, Dec., 1892, and Jan., 1893.
7. Report on Child-Study. *Proceedings South Carolina State Teachers' Association*, 1894.
8. Discussions of Dr. Stanley Hall's Address on Child-Study. *Proceedings National Educational Association*, 1894.

H. P. JOHNSON, Ph.D., Assistant Professor of Biology (*ad interim*).

1. Amitosis in the Embryonal Envelopes of the Scorpion. *Bull. Mus. Comp. Zoöl. at Harv. Coll.*, vol. XXII, pp. 127–161 (3 plates); 1892.
2. A contribution to the Morphology and Biology of the Stentors. *Jour. of Morphology*, vol. VIII, pp. 467–562 (4 plates); 1893.
3. The Plastogamy of Actinosphærium. *Jour. of Morphology*, vol. IX, pp. 269–276; 1894.

E. B. McGILVARY, Ph.D., Instructor in English.

1. Revision of a translation of the Gospel of Matthew from the original Greek into the Lao. Chiengmai, Siam. 1893.
2. The Acts of the Apostles, translated from the Greek into the Lao. Chiengmai, Siam. 1893.
3. The Gospel of John, translated from the Greek into the Lao. Chiengmai, Siam. 1894.
4. The Gospel of Luke, translated from the Greek into the Lao. Chiengmai, Siam. 1894.
5. A series of articles in *The Independent*, New York, illustrative of some features of Lao manners and customs.

WM. A. MERRILL, Ph.D., Professor of the Latin Language and Literature.

1. How the Germans study Philology. *Education*, Nov., Dec., 1887.
2. Some peculiarities of diction and syntax in Cicero's De Legibus. *Proceedings of Am. Phil. Ass'n*, 1887.
3. The teaching of Vergil. Some defects in preparatory work. *Jour. of Education*, Dec. 22, 1887.
4. Vergil and Latin pronunciation. *Jour. Education*, June, 1888.
5. The changes in the Roman Constitution proposed by Cicero in the De Legibus. *Proc. of Am. Phil. Ass'n*, 1888.
6. Vergil or Cicero; which should precede? *Academy*, June, 1888.
7. Hale on the *Cum* constructions. *Education*, May, 1888.
8. How to teach Cæsar. *Jour. Education*, May, 1888.
9. German programs. *Nation*, Feb., 1889.
10. Macaronic poetry. *Miami Journal*, Feb., 1889.
11. College lectures and examinations. *Nation*, April, 1889
12. Clerical jesting. *Nation*, April, 1889.
13. Aim of college Latin course. *Ohio College Ass'n*, 1889.
14. The etymology of *Janus*. *Nation*, Dec., 1884.
15. Short O and short A. *Nation*, Dec., 1885.
16. Corruption of English. *Nation*, Dec., 1887.
17. The Degree of A.B. *Nation*, Feb., 1887.
18. The practical value of a liberal education. *Education*, March, 1890.
19. Sanctii Minerva and early Spanish philology. *Am. Phil. Ass'n*, 1890.
20. Classification of public documents. *Library Journal*, April, 1891.
21. Signification and use of the word *Natura* in Lucretius. *Proc. of Am. Phil. Ass'n*, 1891.
22. Chase's edition of Horace. *Educational Review*, Sept., 1892.
23. Alliteration in Lucretius. *Proc. of Am. Phil. Ass'n*, 1892.
24. Ashmore's "Terence." *Independent*, April 5, 1894.
25. Preston & Dodge's "Roman Private Life." *Classical Review*, Oct., 1894.
26. Vollmer: De funere publico. *Classical Review*, June, 1894.
27. Froehde: Probus and Pliny. *Classical Review*, June, 1894.
28. Lucretius, Book III. Nearly ready for the "Students' Series." Boston.

FINANCIAL STATEMENT.

NOTE.—The Act of the Legislature of the State of California, entitled "An Act to provide for the permanent support and improvement of the University of California by the levy of a rate of taxation and the creation of a fund therefor," approved February 14, 1887, contains the following provisions:

Section 5. The money derived from said fund must be applied only to the support and permanent improvement of the University, and the Board of Regents must include in its biennial report to the Governor a statement of the manner and for what purposes the money was expended.

The following statement shows in outline the manner and purposes of the expenditures of the State University Fund for the fiscal years 1892–93 and 1893–94. Statements showing these expenditures in detail are given in the Annual Report of the Secretary of the Board of Regents for the years mentioned, copies of which are sent herewith:

RECEIPTS.

	1892–93.	1893–94.
Cash on Controller's warrants	$115,575 06	$118,123 39

DISBURSEMENTS.

Advertising and printing	$340 15	$205 55
Department of Botany	317 15	442 78
Department of Biology	636 02	822 93
College celebrations	1,082 45	257 70
College of Chemistry	16,334 63	17,466 91
College of Civil Engineering	13,768 08	13,141 84
College of Letters	------------	13,491 67
Equipment	4,706 44	2,045 95
Repairs	3,245 64	2,510 87
Fuel	987 95	1,096 53
Library	3,064 90	6,908 36
Lick Observatory	25,608 15	25,748 60
Department of Mineralogy	224 44	585 90
Department of Military Science	297 43	324 14
Museum	1,091 07	2,913 43
Official lecturing expenses	2,008 82	2,238 20
Physical culture	4,711 74	4,073 43
Department of Physics	1,155 31	715 45
Postage	568 00	458 00
Printing monographs	------------	730 91
Rent of Board room	408 00	------------
Stationery	314 53	272 14
Telegraphing and expressage	541 88	522 91
University Extension	83 35	86 95
University Printing Office	1,964 37	1,942 85
University site improvements	4,702 40	5,864 10
Water supply	2,412 16	2,134 99
Reserved for permanent improvements	25,000 00	11,120 30
Totals	$115,575 06	$118,123 39

UNIVERSITY OF CALIFORNIA.

BIENNIAL REPORT

OF THE

PRESIDENT OF THE UNIVERSITY

ON BEHALF OF THE BOARD OF REGENTS,

TO HIS EXCELLENCY THE GOVERNOR OF THE STATE.

1894-1896.

SACRAMENTO:
A. J. JOHNSTON, : : : : : : SUPERINTENDENT STATE PRINTING.
1896.

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REPORT OF PRESIDENT OF THE UNIVERSITY.

UNIVERSITY OF CALIFORNIA,
BERKELEY, CAL., September 1, 1896.

To his Excellency JAMES H. BUDD, *Governor of the State of California:*

SIR: On behalf of the Regents of the University of California, I have the honor to submit our biennial report for the years 1894–96.

The following changes have taken place in the Board of Regents since the date of the last report:

Regent George Jennings Ainsworth died on the 20th day of October, 1895, at Portland, Or. Mr. Ainsworth was a graduate of this University, in the first class (1873) which entered after the organization of University instruction. Ten years after graduation he was appointed a Regent. Business necessities kept him much at a distance from San Francisco, but while in near residence he was a faithful attendant on the sessions of the Board. His upright character, business ability, and gentlemanly bearing won him the high esteem of his fellow Regents.

J. B. Reinstein, Esq., of the same University Class of 1873, was appointed to fill the vacancy caused by Regent Ainsworth's death.

The terms of two Regents expired March 1, 1896; viz., Hon. Timothy Guy Phelps and Columbus Bartlett, Esq. Mr. Phelps was reappointed to succeed himself. Regent Reinstein was appointed to succeed Mr. Bartlett. John Eliot Budd, Esq., was appointed to fill out the unexpired term of Regents Ainsworth and Reinstein.

Since the date of the last report, the following changes have taken place in the list of those engaged in the work of instruction at Berkeley:

Professor E. L. Greene resigned his position to accept the Professorship of Botany in the Catholic University at Washington.

Associate Professor Harold Whiting resigned his position in the Department of Physics, at the close of the year 1894–95. With his family he was lost by the shipwreck of the "Colima," in June, 1895, off the coast of Mexico. He was much beloved by his associates in the Faculty, and his untimely death brought grief to the whole community. It was found that he had made a generous bequest to our Department of Physics in the gift of $20,000 for the establishment of an instructorship.

Instructors Franklin Booth, F. G. Burgess, F. E. Haynes, Marshall A. Howe, S. D. Huntington, C. W. Leach, L. J. Richardson, and J. A. Sladky have terminated their connection with the University.

New Instructors still on the list are W. C. Blasdale, B.S., L. F. Chesebrough, Clive Day, A.B., Gustave Faucheux, B.L., J. H. Gray, Jr., B.S., Walter M. Hart, A.M., A. P. Hayne, Ph.B., E. A. Hersam, C. S. H. Howard, A.B., W. L. Jepson, Ph.B., B. R. Maybeck, E. B. McGilvary, A.M., J. C. Merriam, Ph.D., Clifton Price, Ph.D., and E. H. Simonds, B.S.; and, beginning with the new year, K. C. Babcock, Ph.D., in the Department of History, and W. J. V. Osterhout, A.M., in that of Botany.

The following Instructors have been promoted to Assistant Professorships: Wm. D. Armes, M.L., L. T. Hengstler, Ph.D., Myer E. Jaffa, M.S., Exum P. Lewis, Ph.D., H. I. Randall, B.S., W. J. Raymond, B.S., L. DuPont Syle, A.M.

Assistant Professors A. F. Lange, Ph.D., G. M. Richardson, Ph.D., and Edmond O'Neill, Ph.B., have been promoted to be Associate Professors, in English Philology, Classical Archæology, and Organic and Physiological Chemistry, respectively.

Professor William A. Setchell, Ph.D., has succeeded Professor Greene in the chair of Botany. Professor Setchell received the degree of A.B. from Yale, the degrees of A.M. and Ph.D. from Harvard. He was for several years in charge of one department in the Marine Laboratory at Wood's Holl; and at the time of his election to our professorship he was Assistant Professor in the Sheffield Scientific School.

In the year 1872, Edward Tompkins, Esq., one of the earliest Regents and one of the stanchest friends of this University, deeded to the Regents a tract of land for the establishment of the "Agassiz Professorship of Oriental Languages and Literature." The land was to be held until the income of $50,000 could be realized from its sale. Its value was slow to reach the required point, and it was not till the summer of 1895 that the Regents could regard the professorship as established, and proceed to appoint an incumbent. Then their choice fell upon John Fryer, LL.D., an English scholar who had long lived in China, and had been for many years in the Chinese imperial service as a promoter of education among the higher classes of the country. His chief duties were to prepare text-books in science, history, and other studies. He wrote many treatises himself, and translated many others. This work has brought him into close relations with the leading men in the empire, and given him a position of acknowledged eminence. He has received the Third Degree of Brevet Civil Rank. He begins service in our University with the year 1896–97, and is prepared to give instruction in the Chinese language, and to lecture on the language, the literature, the philosophies, the religions, and the history of the Chinese people. His Chinese library is valuable, and contains a copy of the great Chinese Encyclopædia of over 1,600 volumes. The classical Japanese literature will also receive attention from Dr. Fryer.

The word "Oriental" has other well-known applications than to China and Japan, but it is known that Mr. Tompkins had these countries in view in making this early donation to the University. He had glowing visions of the expansion of commerce on the shores of the Pacific, and believed that our relations with these nations would assume the greatest commercial importance.

Professor Greene had leave of absence the first half of the year 1894–95, and resigned at the close of that year. Assistant Professor Ritter returned in 1895 from his year's absence in Europe. Instructor George M. Stratton has been absent on leave during two years, and now returns to take charge of the Psychological Laboratory in the Department of Philosophy. He has gained high distinction in his studies under Professor Wundt, at Leipzig, and has taken his degree *summa cum laude*. His thesis is to appear in Professor Wundt's *Studien*.

Summer Schools have been held in the Departments of Chemistry and Physics, and have been well attended, especially by teachers from the schools of higher grade. The Department of Biology has had charge of expeditions to the seaside. In two of the Engineering Colleges (Mining and Civil Engineering), a certain amount of summer vacation work is prescribed for the completion of the courses. It is desirable that summer work should be more largely organized, and put on a more substantial basis. There is a demand for instruction in a wider range of subjects during the long vacation, and the climate at Berkeley is very favorable for study in midsummer. The attendants on our Summer Schools this year have presented to the Board of Regents resolutions expressing their great satisfaction with the instruction given; and also asking, in the name of many teachers throughout the State, that courses be offered in a larger number of subjects. The subjects having the first claim are those which fit teachers for their specialties in High School instruction; to which must be added Pedagogy and Psychology. Continuous work cannot be done by the Professors the year round, and it needs a stronger teaching force to conduct these extra schools. But they are of great utility, and, like the University Extension Courses, are important means of increasing the University's power for good.

It is not necessary that all additions to the corps of teachers should be for full employment. Our "Organic Act" (Section 13) suggests the great utility of employing for "courses of instruction which are brief and special" a class of "non-resident professors." Taking this last phrase in a wide sense, it will not be difficult to secure for brief periods the services of men of literary or scientific repute as assistants for the expanding work of the University. They can spare a fraction of their time for special instruction in the subjects which enlist their chief interest. This will be true especially of Summer Schools at Berkeley, of Farmers' Institutes in different parts of the State, and of work in

Teachers' Institutes, as held in the several counties. It will be measurably true of University Extension Courses, although here our oldest and best known professors should be called on to do their part.

It is worth while to speak again of the difference between the permanent teachers and the transient. To the former, extraordinaries excepted, belong Professors and Associate Professors; to the latter, Assistant Professors, Instructors, and (to some extent) Assistants. Our procedure in appointing the second of these classes has not been quite consistent. As has been set forth in a previous report, Instructors cannot ordinarily expect to remain as fixtures in a University Faculty. Only a few can be promoted to permanent positions. The majority must come and go; and the usual term of their appointments should be for a single year. The conditions are similar for Assistant Professors; but this higher grade of instruction calls for appointment to a longer term of service. When the appointment expires, the University is under no obligation to renew it. We have sometimes announced that all such appointments are at the pleasure of the Board, and can be terminated at the close of any year without ground of complaint. But as recommendations for subordinate service are usually received from heads of departments, there is a delicacy of personal relations which may prevent the discontinuance of an indefinite appointment at the right time. For this reason it is better to regard all such service as a matter of fixed arrangement, its business side being so prominent as to eliminate personal claims and personal feelings. If one makes himself indispensable to a department, he may expect to be retained; otherwise he completes his contract and goes forth to win further recognition in some other field. It is often the best thing for a young man to know that he is to do journeyman service on his way to permanent professional work.

University Extension Courses have been given, as noted in the report of the Dean. To these may be added as virtual Extension work within the borders of the State, lectures before Teachers' Associations by numerous members of the Faculty, courses at the Coronado Summer School, and at Chautauqua gatherings at Long Beach and Pacific Grove. Not a few addresses have been given at the Commencement exercises of the High Schools.

Our University community has received an intellectual quickening in the Commencement weeks of the past two years, from addresses before the Philosophical Union. Last year two of our own graduates, Professor Royce, of Harvard University, and Professor Mezes, of the University of Texas, gave able addresses to as many hearers as could be crowded into our Gymnasium. These addresses, supplemented by criticisms from Professor Howison, president of the Union, and Professor Le Conte, were published, and have attracted much attention. This year Professor John Watson, of Kingston, Canada, gave a series of lectures before the

Union, and was greeted by a very appreciative audience. The Hon. Wm. T. Harris is engaged for a like service in December of this year.

Farmers' Institutes have been held in various parts of the State; and in connection with those in Southern California, the University has been fortunate in securing the services of Professor A. J. Cook, of the College at Claremont.

A special gathering of agriculturists and horticulturists was held, under local auspices, in August, 1895, at Camp Roache, in the Santa Cruz Mountains, with popular lectures at San José. The members of our Agricultural staff were called on to take an active part in these proceedings. The meetings were so successful that a similar gathering was held this year, with courses of lectures assigned to Professors Hilgard, Wickson, and Woodworth, and Instructor Hayne.

By a vote of the Regents, in June of this year, an expansion of the outside work for the benefit of California agriculture will continue during the ensuing year. A special appropriation was made to meet the contingent expenses of fifty agricultural meetings. Arrangements have been made for the first few series of these meetings, and they are already in progress. No expenditure of funds, it is believed, can more quickly and amply repay the State than that which is devoted to the diffusion of scientific intelligence among the cultivators of the soil. If no other benefit is reaped, at least many costly mistakes can be avoided. But positive benefits are sure to follow the knowledge imparted by thoughtful students of agriculture. The University can give much valuable information; and it expects to learn much from these conferences with practical agriculturists, horticulturists, and vineyardists.

Some recent publications in the newspapers of the State render it proper to speak again (see the last two Biennial Reports) of the service rendered to the State by our College of Agriculture. Its work is always twofold; one part carried on with the classes at Berkeley, the other and more important part that which is done for the State at large. Farmers' Institutes are only incidents in the aid this College is all the while giving to people at a distance from the University. It maintains a voluminous and continually increasing correspondence with individuals in all parts of the State. Calls for information are cheerfully responded to. The department is constantly examining or analyzing specimens sent by numerous inquirers. This work goes on through all the months of the year. The Experiment Stations, in different parts of the State, present constant object lessons in practical agriculture. The careful reports sent out from the college, on soils, fertilizers, adaptation of crops, dairying, stock-feeding, olive-growing, grape and vine culture, choice of fruits, resistance to insect pests, etc., are of exceeding value to the industries of the State. In the matter of reclaiming and utilizing alkali soils, the studies made by the Station workers have been of great practical service, and have received recognition wherever in the world such lands exist. The College of Agriculture, in such outside ways, is in intimate connection with all cultivators of the soil.

When we turn to the home-work of the College, we find that the chief criticism falls on its showing of graduates at Berkeley. That no more take the degree of this College cannot be due to any fault of organization or instruction. The Board of Regents acknowledge no lack of interest and effort in giving this College a foremost place. It receives its full share of the funds. The head of the College is one of the most distinguished scientific agriculturists in the whole country. Ample courses of instruction are provided in the wide field of agricultural study. These courses must be thorough, or they will not fully equip the graduates of the College to go forth and instruct the farmers of the State. The time is near at hand when agricultural subjects will be taught in the High Schools and Common Schools; and no one can face the children brought up on a ranch, who has not some superior knowledge to impart. Expert agriculturists will be wanted to spread information from the Experiment Stations, and to write up agricultural subjects in the weekly or daily press. Such teachers must go forth from an Agricultural College, and must have had thorough training there. Compare Director A. C. True's Report on Experiment Stations, for 1895, pp. 138–9, in which he says: "The development of Agricultural Colleges and Experiment Stations, and the increase in the number and importance of industries allied to agriculture, which demand workers trained in agricultural science, have made the need for thorough courses in Agricultural Colleges in this country more imperative. * * * In obedience to the growing demand for more thorough instruction, our Colleges of Agriculture are gradually raising the grade of their courses which lead to graduation and degrees."

With such provision as we have for the study of agriculture, whose fault is it, if comparatively few take advantage of the four years' curriculum and come out as graduates in agriculture? Do the farmers themselves send their sons to this chosen line of study? Do they give the needed impulse and enthusiasm to make young men love scientific farming? Let us begin further back, and put the spirit of agricultural study into the preparatory schools, and especially into the homes of the farmers.

The number of students in this College is not to be measured by the number of its graduates. Most of its students come for a shorter period of study than four years. They take special agricultural courses and return to their homes. But, more important still, a large number of four-year students enrolled in other Colleges of the University come into certain classes of the College of Agriculture. About one hundred have this year been enrolled in the classes of the Agricultural Professors and Instructors.

We have wished to maintain practical courses for those who can spend but a portion of the year in residence. This desire has been partially thwarted by the peculiarities of the California climate. In the far Northern States, during several winter months, the farmers' sons are relieved from field work. Here there is no such idle season: no month in the year can be called a farmers' vacation. But we still hope to find encouragement for short practical courses at Berkeley which will be attended by a very considerable number of special students.

It has been suggested that an Agricultural College does not thrive in a University, where many other lines of study are pursued. If that is true at Berkeley, it is not because of any preference shown to other studies. And the Regents are sure that it is not because of any feeling of disparagement, on the part of Regents, Faculty, or students. The College of Agriculture is held in equal honor with the other Colleges.

Why then are there so few graduates, in comparison with those of Agricultural Colleges which stand by themselves? In the first place, the comparison is most unfair. Segregated Colleges never confine themselves to agricultural studies. They teach a wide range of general studies, which with us are found in the other Colleges; sometimes even the classics, which are so much objected to; usually history and the studies preparatory to law; biology, and the studies preparatory to medicine; pedagogy, and the studies preparatory to professional teaching. Graduates of segregated Agricultural Colleges go into all those professions: it is a small minority who become professional agriculturists. This is true of all such Colleges that have a high grade of requirement for graduation. One of these, which was established early, on a narrow curriculum, and purposely placed far from other educational centers, gradually enlarged its range of studies to meet the requirements of its patrons, while remaining *par excellence* the Agricultural College of a great State. But in its last report we find the following reference to the students who take the course leading to a purely agricultural degree: "A most gratifying feature of the work of the year has been the increased number of students in the regular four years' course in Agriculture, there being now three Sophomores and three Freshmen entered in this course. While the number is comparatively small in itself, it is yet a marked increase over previous years." Of course many other students were all the while taking shorter courses in agriculture, or coming in from other courses in the College.

That is from one of the oldest of the segregated Agricultural Colleges. One of the youngest, which is still without buildings of its own, has a president who will teach "Mental and Moral Sciences," and a Professor who will teach "Latin and English." So hard is it, in any agricultural community, to satisfy the public with a narrow agricultural course. So sure is it that the farmers themselves are responsible for the failure to bring out a large number of thoroughly equipped graduates in agriculture.

It may be worth while in this connection to refer to the language of the Congressional Act "donating public lands to States and Territories which may provide Colleges for the benefit of agriculture and the mechanic arts": the donation is to be devoted to the "endowment, support and maintenance of at least one College, where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the Legislatures of the States may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life."

The accrediting system has been continued with manifest advantage to the Preparatory Schools and to the University. In the year 1894–95 the usual appropriation was made for the expenses of visiting examiners. In 1895 the Regents sought to economize by cutting off this appropriation. It was thought that the work might be allowed to lapse for a single year. But numerous protests came from all parts of the State, affirming the great advantage to the schools of the accrediting system, and the harm which would ensue from a single year's cessation. It was strongly averred that this connection of the University with the High Schools had been of the greatest service to the schools. Influenced by these calls, the Regents at last made half the usual appropriation, which was used to the best of their ability by five of the leading departments in the University. The number of accredited schools in 1894 was 48; in 1895, 57; in 1896, 67, of which 52 are public High Schools in all parts of the State.

The time has come to have a clear understanding of the relations involved in this accrediting system. They seem simple enough, but in certain quarters they have been objected to as bringing an arbitrary power to bear on the schools and on individuals.

Accrediting was first introduced here in imitation of the system employed at the University of Michigan. But it was made more thorough in its working, by commissioning a larger corps of examiners. We send out experts in all the leading subjects required for entrance to the College classes. We accredit the school only in those branches in which it makes a satisfactory showing. In addition to the school diploma, we require the personal recommendation of the Principal of the school. When these conditions are met, the students from accepted schools come in without examination in all the accredited branches of study.

Accrediting is entirely voluntary on the part of the schools. The

University sends its examiners only in response to a request from the schools. It is simply, first, an offer of help to the schools, in determining the probable standing of a school in comparison with the other schools of the State; and, secondly, a privilege granted to the graduates of the schools, of coming in without examination at the University. This privilege is greatly prized, and of course it exerts an influence in favor of accrediting. But it must be repeated, that the University itself brings no sort of pressure to bear on any school for becoming accredited. The almost universal request for accrediting arises from the manifest advantages of the system; a system which has now found wide favor throughout the land, and has been adopted (in a less perfect form than our own) in some of the oldest Eastern colleges.

We do not claim that our decisions as to accrediting are infallible. If we err, it is probably on the side of a negative conservatism. We regard the concession as one to be granted cautiously, and where it is not likely to be soon forfeited. In addition to the visits of the examiners, two additional safeguards are resorted to: specimen papers of the regular work of the school; and (after accrediting) a record of the early college work of recommended students. The University has no private ends to gain in all this procedure, it has no personal grudge to gratify. If its decisions affect individuals unpleasantly, it is only incidental to the working of a system which must have less regard to individuals than to the larger interests of the school system of our State. We must insist on a proper University standing, such as is maintained by other first-class Universities; and we cannot maintain such a standard without fit preparation on the part of all incoming students.

As the schools multiply, it becomes a question whether the increasing burden of the examiners' traveling expenses should be borne by the University alone out of its all too scanty general fund. The work is preëminently one for the benefit of the High Schools, as a part of the State system of education.

Professor Joseph Le Conte has taken a half-year's leave of absence, to attend various meetings of Scientific Associations in this country and Great Britain. He will give the President's address before the American Geological Society. He will also represent us at the Princeton celebration in commemoration of the founding of the College of New Jersey, one hundred and fifty years ago. On his return, Dr. Le Conte will devote much of his time to graduate instruction, and hand over to Associate Professors the chief portion of his undergraduate work.

Assistant Professor Leuschner is to be absent for a year, on half-pay. For several years the Board of Regents has been inclined to adopt the Harvard and Cornell plan of a "Sabbatical year," by which a professor, after six years of work, gains a year off with half-pay, for study elsewhere. It is thought very desirable that University men take such leaves of absence, for their own benefit and for the increased value of their teaching service. With us the inducement of half-pay has not proved as strong as at those Eastern institutions. We are so far from European Universities, the expense of travel is so great, that our young Professors are not encouraged to take their Sabbatical year. This is to be regretted; and it raises the question of reverting to some procedure more like that of former years, when some one or more of our force received leave for a year without loss of pay.

At the meeting of the National Educational Association last year, at Denver, the University was represented by Professors Le Conte, Hilgard, and Bacon. The Association met this year at Buffalo, and Professors Brown, Clapp, and Merrill were in attendance.

Professor Brown was also commissioned to represent this University at a meeting of the "Land Grant Colleges," held the same week in Buffalo. An important bill has been introduced in Congress for a grant of supplementary lands to the institutions fostered by the acceptance of the Morrill grant of 1862. The measure is a very important one, especially for the States which, like California, received a much smaller allotment than they would have been entitled to with their present population. The Bill, which is in the nature of an equalizing measure, will be pressed forward in the next Congressional session. It is worthy of serious consideration by our Legislature, that our Senators and Representatives may be stimulated to give it effective support.

At last a movement has been begun to which we have been looking forward ever since the administration of President Gilman. He invited the establishment of independent Seminaries of learning alongside of the University, especially by the various religious denominations. It seemed a wise economy for all educational interests of the higher grade to plant themselves in the neighborhood of the State's University, and avail themselves of the facilities it provides, to which all Californians are equally entitled. Special instruction could be given at the outside home in any subjects emphasized by its founders. More than twenty years ago one religious body purchased a lot in Berkeley, with a view to establishing such an outside home. The project was given up for the time, but it has been constantly borne in mind, and publicly advocated by successive Presidents of the University.

The "Christian Church" has now taken decisive action, and this year it organizes a Seminary in Berkeley. Two professors, Dr. S. M. Jefferson and Rev. A. M. Elston, are in charge of the enterprise, and propose to offer certain courses of instruction in their Seminary. For other courses, their students will enter the University on such footing as they choose, either as regular, or limited, or special students. They come in, of course, on precisely the same terms as other students, and enjoy all the advantages of the University. The economy of this arrangement is evident. Its influence on these new students ought to be helpful, as they are introduced to a wider range of studies and a larger companionship with teachers and fellow-students. Its influence on the University cannot be otherwise than good, so long as these added groups of students are earnest and high-minded, as from the circumstances of their coming they would presumably be. It is proper to add that this movement is more advanced in other States than in our own. Michigan and Missouri are examples of States in which such independent and unaffiliated but coöperating Seminaries have been established, and have shown the wisdom of their founders.

The number of students in attendance at the University during the last two years has been as follows:

Year.	At Berkeley.	In San Francisco.	At Mt. Hamilton.
1894–95	1,124	655	8
1895–96	1,336	717	3

Deducting the few duplicated names, the totals were, for 1894–95, 1,781; for 1895–96, 2,047.

The class entering in the new year, 1896–97, is considerably larger than that of 1895–96.

A comparative table for the last six years gives the following numbers in the various departments of the University. They show, as in former reports, a remarkable increase in attendance:

	1890–91.	1891–92.	1892–93.	1893–94.	1894–95.	1895–96.
In Academic Departments at Berkeley:						
Men	352	383	446	541	725	811
Women	105	164	204	274	399	525
Totals	457	547	650	815	1,124	1,336
At the Lick Observatory:						
Men	3	4	6	5	6	3
Women	0	0	0	2	2	0
Totals	3	4	6	7	8	3
In the Colleges of Law, Medicine,* Pharmacy, Dentistry, and Veterinary Science, and in the Mark Hopkins Institute of Art, in San Francisco:						
Men	302	378	415	474	576	598
Women	9	12	20	92	79	119
Totals	311	390	435	566	655	717
Total in the University (deducting for duplicates)	771	941	1,091	1,383	1,781	2,047

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* Including the Post-Graduate Medical Department.

The numbers graduated from the several Colleges during 1895 and 1896 have been as follows:

		Colleges of General Culture.	Colleges of Applied Science.	Law.	Medicine.	Pharmacy.	Dentistry.	Totals.
In 1895.	Men	53	24	33	24	25	38	197
	Women	38	1	2	2	0	0	43
	Totals	91	25	35	26	25	38	240
In 1896.	Men	57	33	47	44	26	47	254
	Women	46	1	0	7	0	5	59
	Totals	103	34	47	51	26	52	313

The following table shows the increase in the teaching force of the Colleges at Berkeley:

Table showing the Number of Professors, Associate Professors, Assistant Professors, Lecturers, Instructors, Assistants, and Fellows in the Colleges at Berkeley during Each Academic Year—Compiled from the Annual Registers.

Year.	Professors.	Associate Professors.	Assistant Professors.	Lecturers.	Instructors.	Assistants.	Fellows.	Totals.
1890–91	17	5	5	2	8	11	--	48
1891–92	17	8	8	--	13	12	2	60
1892–93	16	9	10	1	19	18	4	77
1893–94	17	9	12	--	20	23	7	88
1894–95	21	9	12	--	24	17	7	90
1895–96	21	10	13	--	26	18	6	94

A comparison of the years 1890–91 and 1895–96, in the numbers of students and the numbers of Instructors, will show how much the average size of the sections, as handled in the various lecture and recitation-rooms, must have increased. They were quite large enough in the former year; now many of them are too large for the best results in instruction. There is more elective and more graduate work than five years ago; and both these factors tend to reduce the size of the sections. Yet the average size of the sections taught by the whole Faculty is at least thirty per cent greater than it was. The increase is greatest in the standard studies of the first two years. That means that some sections in Mathematics, English, History, Latin, Chemistry, Physics, etc., are very much overcrowded. For example, the Department of Mathematics has sections twice or thrice as large as can be thoroughly cared for. The same is true in the modern language departments.

The inference is too plain to need a formal statement. We are in pressing need of larger funds for our salary list. The number of students has very far outrun any increase in our stated income. It is impossible to go on with a larger disproportion between income and necessary outlay. To say nothing of other expenses, the cost of instruction alone has brought the University to an acute financial crisis.

In noting the expenses of the University, it must be remembered that a very considerable sum is demanded every year by the Lick Observatory, of which we are justly proud. The gift of Mr. Lick was almost entirely used up in providing the magnificent plant at Mount Hamilton. The running expenses of the Observatory are over $20,000 a year, of which a round $17,000 comes out of the University funds, with pressing demands for additional workers.

Another thing is to be borne in mind, viz., that every enlargement of the work of the University involves an increase in the running expenses. If a new building is put up, it must have new furniture and equipment. The machinery will suffer wear and tear. The fires demand a new coal supply. A separate janitor must be employed. The surrounding grounds must receive additional care. A large institution, however economically managed, needs a large contingent fund for its maintenance.

The Board of Regents has been much concerned with the financial problem above referred to. Various propositions have found utterance in its counsels. A few Regents have suggested a tuition fee, such as is charged in some other State Universities. More of our number have strongly advocated an incidental fee, such as is now paid, under one name or another, in almost all State Universities. This proposition was voted down by a narrow majority; the opposition to it being based largely on the old and generous Californian feeling that no slightest barrier must be put in the way of those who wish for an education. Still another proposal has been made, to meet the pressing needs of instruction by an overdraft on the future. But this, too, has seemed impracticable. Many would regard it as a business impropriety, and all recognize the fact that the hard times prevailing throughout the State make it hazardous to count on legislative appropriations for any considerable deficit. These propositions being all put aside, we are compelled to spend another year under an aggravation of the financial difficulty. A still larger number of students must be provided for than in any year preceding. We have invited them to our doors, and we cannot turn them away without ample notice of a change of policy.

The Board of Regents would now lay this difficulty before the people of the State, as represented in the coming session of the Legislature. The University is the people's institution, established for their benefit, founded by them with help from the National Government, generously encouraged by them from time to time, and fostered by the grant of a permanent fractional tax. These provisions were adequate for a time. But the growth of the University has exceeded all our expectations. The number of students has more than trebled within the last six years, with little increase in resources, and a crisis has thus been thrust upon us. The people of the State must deal with this new situation, and decide how they wish *their* University to be carried on.

There would appear to be but three choices of method for the University's future. First, to retrace the steps which seem to have pledged us to the principle of absolutely free tuition. This would bring on a strenuous contest, and might necessitate an amendment to the State Constitution. It is not a method of speedy relief. Secondly, a reduction in the number of students. If we have funds for the proper instruction of only 1,000 students, let that be the maximum number admitted. A few portions of the State which have not now their full quota, would not be immediately affected; but many of the most populous counties would suffer a serious reduction. This course would give us a unique reputation among the Universities of the land. All other Universities rejoice in a continued and healthful growth. Other State Universities make provision for all who are prepared to enter. We should lose the small but desirable contingent coming from outside our State. Our graduate department would be struck with paralysis; and graduate study is now a necessity for any first-class University. Thirdly, the natural method would be to increase the amount of State aid. The appropriations heretofore made for buildings met existing demands. The fractional tax aimed to give just the needed subsidy for instruction. Now that the rapid growth of the University renders that aid insufficient, the State is reasonably asked to make it sufficient—just that and nothing more. The next Legislature will be called on to decide whether this is the method the people wish to have adopted.

Other States are now assigning to the support of their Universities a larger fractional tax than ours. For example, Michigan, whose University has become the pride of the State, gives a tax of one sixth of a mill on the dollar; ours is only one tenth. Minnesota gives three twentieths of a mill, half as much again as ours; Indiana, one half of a mill for thirteen years, for endowment. Wisconsin grants a permanent tax of one eighth of a mill, with an additional one tenth for six years for buildings, and another tax yielding $10,000 a year. Missouri gave to its University, in four years, appropriations amounting to nearly $1,300,000.

It is an old story, told in former reports, that the Colleges at Berkeley are in great need of additional buildings. The need was recognized by the committees of the last Legislature. If another University plea of older urgency had not stood in the way, we doubt not that an appropriation would have been willingly granted for buildings at Berkeley. The intervening two years have made the pressure upon us still harder to bear. There are several hundred more students, many more sections to be accommodated. Lecture-rooms, recitation-rooms, laboratories, have been overcrowded by the larger numbers. Our only Assembly Hall has been cut up for recitation-rooms, and there is no place where the new Freshman Class can be gathered. Literary and scientific sections are alike distressed for room, and, as usual, science makes the most pressing claims. The young women in the University, now numbering over 500, have but the poorest accommodations in their overcrowded study and lunch rooms.

Recent action taken by the Board of Regents is an assurance that appropriations for buildings at Berkeley will be wisely expended. A plan for permanent and harmonious structures will be sought for from architects of the highest ability. While the older buildings will not be discarded, but live out their useful lives, every new building will be put in its fitting place, and become an integral part of a far-reaching plan. The beautiful slopes and contours of the University site will lend themselves to picturesque effects of the highest architectural interest.

In consequence of the increased number of students pursuing post-graduate studies, the Academic Senate has established a Graduate Council, to relieve the Academic Council from the care of the graduate students. The enrolled graduates have themselves formed a Graduate Club, which promises the best results in unifying this important body of advanced students. This club coöperates with other clubs in all the leading Universities of the country, in preparing an account of the graduate courses offered at the different institutions. Our experience shows already the need of fostering this advanced department of study. It is the last stage in our educational series, and is needed for the full equipment of Instructors in College courses, and for the better equipment of teachers in the High Schools. If we fail to have a good graduate department, our ambitious young scholars must go abroad for their higher degrees, or yield the most important positions in School and College to strangers who have had superior advantages.

The work of the past two years has shown fidelity on the part of Instructors and students. The number of courses given in 1894–95 was 295; in 1895–96, 313.

Physical culture is now required of young men in the two lower classes three times a week. The Gymnasium is overcrowded, and the lack of accommodations prevents us from making these exercises obligatory for the young women as well as for the young men. There are large volunteer classes of young women, under the care of Mrs. Magee, wife of the Director. This department is among those which are suffering most for lack of new buildings. There is a new interest felt in the introduction of physical culture in the schools of the State. The demand for this will require special training for many of the teachers who go out from the University, and put on this department a new and large responsibility.

The Military Department has grown in importance, and the battalion now numbers over 500. An armory is more than ever a pressing need.

It is expected that provision will be made for a valuable series of lectures, beneficial alike to the Military and Physical Culture Departments.

Athletics come in as a voluntary supplement to the military drill and the exercises of the Gymnasium. The ideal admixture of athletics has not yet been realized. In some cases there is an encroachment on the more important work of the College curriculum. The Faculty endeavor to guard against this tendency, and in no case do they condone poor scholarship on athletic grounds. Their chief regret is that only a minority of the young men obtain the benefit of such hardy outdoor exercise. It is not an ideal condition, when one fifth of the young men represent the student body on the campus, and four fifths are merely spectators. It would be a gain if games of precision, calling for the most laborious practice, were supplemented by styles of play in which all are invited to join.

In the absence of dormitory buildings, there is an increasing tendency among the students to find homes in fraternity houses. Several new fraternities have been introduced within the past two years. These fraternity families depend for their healthful tone on the individual members. At the best, they form pleasant and profitable homes for high-minded and earnest students. With an inferior constituency, they may exert an unfavorable influence, leading to a waste of time, or even a deterioration of character. It is highly important that a young man should have time to act deliberately in the choice of his fraternity companions. Such deliberation is at present impaired by the haste with which pledges are obtained from new-comers. Parents should advise their sons to defer their fraternity membership till they have come to feel at home in the University, and can be sure of the fellowship they enter. This close bond of daily comradeship is one which is to have a very marked influence on their student lives. The fraternities themselves should agree to postpone pledging for at least the first term of the Freshman year. It requires a mutual understanding in order that no unfair advantage may be taken. Such a change from the present method would be beneficial alike to the new students and to the fraternities. Natural affinity would take the place of hasty and incongruous affiliation.

Interesting statistics will be found in the appended Report of the Dean, Professor Irving Stringham.

Since the last report, the California Veterinary College has been affiliated with the University. Appended are reports from the Deans of the Professional Colleges, and the Secretary of the San Francisco Art Association. It will be seen that these departments have shared in the general prosperity of the University.

All the Professional Schools have increased their requirements for graduation, thus keeping in the front rank.

After years of waiting and successive disappointments from adverse gubernatorial judgment, the Professional Colleges in San Francisco obtained an appropriation of $250,000 from the last Legislature for the erection of new buildings in San Francisco, on a common site. A valuable and commanding site was offered by the Hon. Adolph Sutro, and was accepted by the Board of Regents. The plans of the buildings were thrown open to competition; those presented by Messrs. Krafft, Martens, and Coffey were chosen, and the work of construction is to go forward as rapidly as possible. The following vote of thanks to Mr. Sutro was passed at a meeting of the Board held May 19, 1896:

> *Resolved*, That in view of the generous donation of the said site for the Affiliated Colleges heretofore accepted, and the noble plans undertaken and promised by the Hon. Adolph Sutro, as expressed in his letters above set out for founding and endowing a great public library in connection with said Colleges, this Board does now gratefully accept said undertakings so expressed in said letters, and in consideration therefor wil proceed to erect said College buildings upon said site as provided by law, and will earnestly further the design of the Hon. Adolph Sutro in founding and completing the said Library and Library Building; further
>
> *Resolved*, That the Board takes this occasion to express its profound appreciation of the public spirit, devotion to learning, and the good of the commonwealth, so splendidly manifested by the Hon. Adolph Sutro.

The San Francisco Art Association is steadily gaining ground, in the Hopkins Institute, donated by Edward F. Searles, Esq. James D. Phelan, Esq., and Horace G. Platt, Esq., have been Presidents of the Association for the two years under review. Mr. Searles has shown continued interest in the Institute by additional presents and assistance. Valuable collections of paintings have been received from Mrs. Phebe A. Hearst and Mrs. Mary A. Avery; gifts of pictures and books from many others. James D. Phelan, Esq., gave $1,000 to be awarded for pictures painted by California artists.

J. Clute Wilmerding, Esq., made a bequest for an industrial school, and put the trust in the hands of our Board of Regents. The money has been turned over to them, and invested in approved securities. The site of the school is to be definitely determined at the November meeting of the Regents.

Full Annual Reports from Director Holden on the work of the Lick Observatory will be found appended to the Secretary's reports. An expedition to Japan for observing the August eclipse of the sun was conducted by Professor Schaeberle, who was so successful in his expedition to South America, in 1893. One of our Regents, Charles F. Crocker, Esq., bore the expense of this expedition ($2,500), and deserves as sincere thanks as if the skies had been more propitious. A very valuable addition has been made to the equipment of the Observatory by Edward Crossley, M.P., F.R.A.S., of Halifax, England, a noted amateur astronomer. He was in possession of a three-foot reflector, built by Dr. A. A. Common. On deciding to part with it, he generously gave it to us, choosing the Lick Observatory as the place where this fine instrument would be of most service to science. It is a splendid gift, and one which strikingly shows the international union of sympathies in the scientific world. The cost of transporting and remounting this telescope was borne by numerous friends of the Observatory in this State. As Director Holden remarks: "We have contributions from Regents of the University, from a member of the Academic Senate, from a member of the Alumni, from the Astronomical Society of the Pacific, from the Society of California Pioneers, and the California Academy of Sciences, from bankers, manufacturers, railway officials, lawyers, men of business, capitalists—both men and women." The total money gifts were over $5,000. The Southern Pacific Company and the Wells-Fargo Express Company furnished free transportation, thus saving us thousands of dollars. Messrs. Percy & Hamilton, architects, of San Francisco, gave their services in the erection of a new dome on Mount Hamilton. Miss Caroline W. Bruce, of New York, gave $500 to provide a special spectroscope for this telescope; also, a new driving-clock. Mrs. Hearst gave $100 for preliminary experiments in photographing the solar corona. Dr. A. Blair Thaw, of Santa Barbara, has presented a special piece of apparatus for the same use. Professor Weinek, of the Observatory at Prag, has coöperated with the Observatory, as heretofore, in enlarging the photographs of the moon. W. W. Law, Esq., has made a gift of $1,300 for the publication of an Observatory Atlas of the Moon.

Mount Hamilton has sustained a loss in the resignation of Professor E. E. Barnard, whose brilliant work has reflected credit on the Observatory. Since his acceptance of a position in the Yerkes Observatory, he has raised in San Francisco a fund for the publication, in our L. O. series, of illustrations of his Milky Way and Comet photographs. Professor W. S. Hussey has taken the place of Professor Barnard at Mount Hamilton.

Director Holden asks for the strengthening of his little band of astronomers. He claims a fellowship as an immediate necessity. In comparison with other celebrated Observatories, the Lick Observatory is very imperfectly manned. Its salary roll, he thinks, should be increased at once by $3,600; with a budget apportionment of $7,500 additional. At that figure it would be by far the most economically conducted of the great Observatories. He calls attention to the need of purchasing adjacent bits of land on Mount Hamilton.

The number of visitors registered at the Observatory the past year was 4,838; the total number from June 1, 1888, to June 1, 1896, is 43,536. On the 25th of August of this year, one hundred years since the birth of

James Lick, a memorial day was observed at Mount Hamilton, where the remains of Mr. Lick find a tomb under the great telescope.

Mr. Herman Royer, a business man of San Francisco, some years ago made a will, by the terms of which most of his estate was to be given for founding a chair of Political Economy in this University. After Mr. Royer's death, which occurred last year, it was found that his property was so much encumbered as to defeat his good intention in the matter. If the University gains nothing more, it will have the benefit of his excellent example. Such a bequest should cease to be a rarity. Mrs. Julie Rosewald has generously given a considerable sum for the founding of a scholarship in memory of her deceased husband. Mrs. Phebe A. Hearst, who many years ago established eight scholarships for young women, last year added four more temporary scholarships. Twelve worthy young women are now recipients of her benefaction. James D. Phelan, Esq., of San Francisco, has given $500 for the support of a Fellow in Argumentation during the present year. He does this in the hope that, if the experiment is a success, the Regents may find themselves able to continue the Fellowship another year, or that others interested in debating may combine to place the Fellowship upon a permanent foundation.

The Library of the University has been enriched by many minor gifts of books, and by some of larger extent. Noteworthy are the following: 403 volumes of Law Reports and Digests, presented by the Bancroft-Whitney Company and nine Alumni of the University; 50 volumes of the "Challenger" Reports, presented by the Government of Great Britain; numerous volumes and manuscripts on Quicksilver Mining from J. B. Randol, Esq.; 44 volumes of the Iron Age, from Regent A. S. Hallidie; 26 volumes on Engineering and Metallurgy, from Marsden Manson, Esq.; a set of San Francisco Municipal Reports, from Wm. Alvord, Esq.; California Authors, 29 volumes from S. P. Avery, Esq., and more from others; 100 volumes for the Department of Physics, from Miss Rose Standish Whiting. Portraits of Benjamin Parke Avery, from his brother S. P. Avery, and of Dr. Horatio Stebbins, have been placed in the Library. The presentation of the latter portrait, by John Perry, Esq., and other donors, was a pleasant feature of the Charter Day exercises, March 23, 1896.

Messrs. Levi Strauss, Louis Sloss, J. L. Flood, and G. W. McNear have made a donation of $250 each for lighting the Library. Many citizens of Berkeley gave another $1,000 for lighting the grounds, one half the sum coming from Frank M. Wilson, Esq. Four gentlemen of San Francisco, two of them now Regents, gave $100 to the Department of Astronomy.

C. Pischli, Esq., donated mountings for the Students' Observatory. A friend presented one hundred iron settees for use on the grounds. The

Berkeley Electric Lighting Company makes a very generous donation toward lighting the University grounds.

Valuable gifts have been received from the General Electric Company, San Francisco, through Dr. Thomas Addison, Manager; from the Union Iron Works; from Professor George Davidson; and from others.

It is proper to notice as gifts the gratuitous service rendered in teaching. Professor Jacob Voorsanger, D.D., of San Francisco, has for two years given two forenoons in each week to classes in his department of Semitic Languages and Literature. J. C. Merriam, Ph.D., now an Instructor, performed a year's gratuitous work in the Department of Palæontology. There have been Honorary Fellows and Assistants in several departments, who received no compensation for valuable services. On the University grounds Mr. John McLaren, of the Golden Gate Park, has given advice and time with his characteristic public spirit.

And why may we not count the gift of the student body, who turned out in large numbers to make a new roadway in the University grounds, improved existing paths, and leveled the rocky ground about some of the buildings? The University had not the funds to pay for these improvements, and hundreds of the students, day after day, wielded the pick and the shovel, doing jobs that would have cost thousands of dollars. An incidental benefit of this work is the light thrown on the character of our students. As a class they know how to work, and are not expecting to live lives of luxury and idleness. A very considerable percentage are partly or entirely supporting themselves in their four years of study. A Students' Aid Society has been formed, which is a medium of communication between needy students, both men and women, and those who can give them employment.

Appended is a list of the published writings of members of the Faculties since the printing of the former lists.

The customary financial statement is also subjoined. The report of the Secretary of the Board gives full details of the Board's business transactions.

Respectfully submitted.

MARTIN KELLOGG,
President of the University of California.

SUBSIDIARY REPORTS.

Of the Dean of the Colleges at Berkeley.

Of the San Francisco Art Association.

Of the Dean of the Medical Department.

Of the Secretary of the Post-Graduate Medical Department.

Of the Dean of the College of Dentistry.

Of the Dean of the College of Pharmacy.

Published Writings of Members of the Faculty.

Financial Statement.

REPORT OF THE DEAN OF THE COLLEGES AT BERKELEY.

To the President of the University:

Dear Sir: I have the honor to submit herewith the following report on attendance and courses of instruction in the Colleges of Letters, Agriculture, Mechanics, Mining, Civil Engineering, and Chemistry, for the academic years 1894–95 and 1895–96.

The following table gives the number of students in attendance each year from 1885–86 to 1895–96, inclusive, classified by status. The upper figures on the left of each column refer to young men, the lower to young women; the numbers in the lower right-hand corner of each group are the totals:

Enrollment by Classes.

	1885–86.	1886–87.	1887–88.	1888–89.	1889–90.	1890–91.	1891–92.	1892–93.	1893–94.	1894–95.	1895–96.
Grad.	11 2 13	8 1 9	8 4 12	15 0 15	15 6 21	20 5 25	22 15 37	34 13 47	43 21 64	60 40 100	73 45 118
Sen.	13 4 17	29 5 34	29 3 32	34 4 38	32 7 39	40 4 44	28 8 36	27 10 37	44 22 66	79 34 113	83 47 130
Jun.	30 5 35	37 4 41	34 3 37	36 8 44	45 6 51	29 7 36	32 12 44	36 9 45	38 19 57	106 44 150	126 61 187
Soph.	40 4 44	45 5 50	40 10 50	53 13 66	34 12 46	43 12 55	46 8 54	47 14 61	48 23 71	136 62 198	204 102 306
Fresh	63 6 69	68 8 76	75 18 93	80 13 93	76 18 94	67 11 78	75 19 94	65 18 83	79 25 104	231 109 340	211 122 333
At Large	11 0 11	14 1 15	26 2 28	31 5 36	54 11 65	82 26 108	113 45 158	148 64 212	182 75 257	-------- --------	-------- --------
Spec'l	12 4 16	16 5 21	21 5 26	27 12 39	26 17 43	30 17 47	41 40 81	58 53 111	62 66 128	72 80 152	77 108 185
Lim.	27 18 45	26 16 42	19 9 28	15 17 32	26 16 42	42 22 64	26 17 43	31 23 54	45 25 70	41 30 71	37 40 77
Totls.	207 43 250	243 45 288	252 54 306	291 72 363	308 93 401	352 105 457	383 164 547	446 204 650	541 274 815	725 329 1,124	811 525 1,336

Classified by College as well as by status, the statistics of attendance during the past two years are as follows:

ACADEMIC YEAR 1894–95.

GRADUATES.

Cand. Ph.D.	16 4 20	Cand. A.M.	9 5 14	Cand. M.L.	4 8 12	Cand. M.S.	4 1 5

Graduates pursuing Special Subjects	27 22 49	Total Graduate Students	60 40 100

UNDERGRADUATES.

	Sen.	Jun.	Soph.	Fresh.	Sp.	Lim.	Totals.
Letters	15 8 23	12 5 17	15 9 24	24 14 38	3 3 6	4 1 5	73 40 113
Social Sciences	34 23 57	44 36 80	60 50 110	108 82 190	21 48 69	21 28 49	288 267 555
Natural Sciences	4 2 6	4 2 6	3 3 6	7 9 16	5 8 13	1 0 1	24 24 48
Agriculture	0 0 0	1 0 1	3 0 3	3 1 4	7 1 8	0 1 1	14 3 17
Mechanics	6 0 6	20 0 20	26 0 26	36 0 36	7 6 13	7 0 7	102 6 108
Mining	5 0 5	2 0 2	11 0 11	12 0 12	8 0 8	1 0 1	39 0 39
Civil Engineering	8 0 8	14 0 14	11 0 11	26 0 26	12 10 22	2 0 2	73 10 83
Chemistry	7 1 8	9 1 10	7 0 7	15 3 18	9 4 13	5 0 5	52 9 61
Totals	79 34 113	106 44 150	136 62 198	231 109 340	72 80 152	41 30 71	665 359 1,024

Total in the Colleges at Berkeley	725 399	1,124

ACADEMIC YEAR 1895–96.

GRADUATES.

Cand. Ph.D. $\left\{\begin{matrix}18\\5\end{matrix}\right.$ 23 Cand. A.M. $\left\{\begin{matrix}16\\8\end{matrix}\right.$ 24 Cand. M.L. $\left\{\begin{matrix}2\\8\end{matrix}\right.$ 10 Cand. M.S. $\left\{\begin{matrix}5\\2\end{matrix}\right.$ 7 Cand. C.E. $\left\{\begin{matrix}1\\0\end{matrix}\right.$ 1

Graduates pursuing Special Subjects $\left\{\begin{matrix}31\\22\end{matrix}\right.$ 53 Total Graduate Students $\left\{\begin{matrix}73\\45\end{matrix}\right.$ 118

UNDERGRADUATES.

	Sen.	Jun.	Soph.	Fresh.	Sp.	Lim.	Totals.
Letters	11 4 15	14 10 24	19 12 31	19 19 38	3 5 8	5 3 8	71 53 124
Social Sciences	35 37 72	58 49 107	93 77 170	98 91 189	30 76 106	20 36 56	334 366 700
Natural Sciences	7 5 12	6 2 8	8 11 19	13 11 24	4 11 15	1 0 1	39 40 79
Agriculture	2 0 2	1 0 1	3 1 4	2 0 2	2 2 4	1 1 2	11 4 15
Mechanics	9 0 9	25 0 25	37 0 37	32 0 32	13 8 21	4 0 4	120 8 128
Mining	0 0 0	9 0 9	19 0 19	20 0 20	10 0 10	2 0 2	60 0 60
Civil Engineering	11 0 11	8 0 8	15 0 15	12 0 12	8 2 10	1 0 1	54 2 56
Chemistry	8 1 9	5 0 5	11 1 12	15 1 16	7 4 11	3 0 3	49 7 56
Totals	83 47 130	126 61 187	204 102 306	211 122 333	77 108 185	37 40 77	738 480 1,218

Total in the Colleges at Berkeley $\left\{\begin{matrix}811\\525\end{matrix}\right.$ 1,336

The numbers of persons upon whom degrees have been conferred during the past five years, on the recommendation of the several Faculties at Berkeley, are given in the following table. In a few instances a degree (or possibly more than one degree) was conferred before or after Commencement. The statistics are, in each year, except 1896, for the calendar year—January to December, inclusive:

Name of Degree.	1892.	1893.	1894.	1895.	1896.*
Sc.D.†	-------	2 0 2	-------	-------	-------
Ph.D.	-------	1 0 1	2 0 2	-------	2 0 2
A.M.	1 1 2	2 0 2	4 1 5	2 1 3	3 1 4
M.L.	0 2 2	-------	-------	2 2 4	1 4 5
M.S.	-------	0 1 1	2 0 2	-------	4 1 5
Number of higher degrees	1 3 4	5 1 6	8 1 9	4 3 7	10 6 16
A.B.	8 3 11	9 1 10	13 5 18	14 8 22	11 4 15
B.L.	6 4 10	2 7 9	15 14 29	15 18 33	10 23 33
Ph.B.	13 8 21	20 9 29	10 14 24	16 6 22	23 10 33
B.S.	15 2 17	21 1 22	22 2 24	28 4 32	35 5 40
Number of Bachelor's degrees	42 17 59	52 18 70	60 35 95	73 36 109	79 42 121

* To August 10th. † Honorary.

There were given by lecture, recitation, laboratory experiment, in the drawing-room and in the field:

295 courses of instruction during the year 1894–95.
313 courses of instruction during the year 1895–96.

The enrollment in the various classes is exhibited in the following table:

ENROLLMENT IN THE COURSES OF INSTRUCTION FOR THE YEARS 1894–95 AND 1895–96.

NOTE.—An unbroken line in column headed "No. of Students" indicates that there is no report on the course. A dotted line in column headed "No. of Students" indicates that the course was not given.

Instructor.	Title of Course.	No. of Hours a Week.		No. of Students in Attendance.	
		One Term	Two Terms	1894–95	1895–96
	PHILOSOPHY.				
Howison; Henderson; Henshaw	1. Formal Logic	4	......	95	144
Howison; Henderson; Henshaw	2. Elementary Psychology	4	......	35	122
Howison; Henderson; Henshaw	3. Introduction to Philosophy, History of Philosophy from Thales to Kant, inclusive	4	......	20	25
Howison	4. Elementary ethics, including Civil Polity	......	2	22	6
Howison	5. The Philosophy of Kant	......	2	19	8
Howison	7. The Philosophy of Plato	......	4	......	10
Howison	8. Hegel's Logic. Seminary	......	3	2	......
Howison	8. Hegel's Logic. Seminary	......	4	......	3
	PEDAGOGY.				
Brown	1. The Practice of Teaching; lectures and observation in schools	4	......	16	22
Bailey	1. (*b*) Recitation and School Visitation	2	......	13	
Bailey	2. (*a*) School Supervision: Textbook and Lectures	2	......	34	36
Bailey	(*b*) Visitation of Schools: organization, grading, management	1	......	7	12
Bailey	3. The History of Education: Earlier periods, to time of Rousseau	3	......	65	96
Bailey	4. The History of Education: The Latest Period, from time of Rousseau to present	3	......	63	82
Brown	5. The Theory of Education	4	......	20	39
Brown	6. School Systems: origin and development, etc.	2	......	......	54
Brown	7. Seminary for the study of special problems in Education	......	2	42	31
Brown; Bailey	8. Graduate Seminary for the systematic study of child-life	......	......	——	——
Bailey	9. Biological Aspects of Education. Primarily for graduates	......	......	9	8
	JURISPRUDENCE.				
Jones	1. Formation of the Federal Constitution	1	......	6	9
Jones	2. Constitutional Law of the United States	......	2	32	45
Jones	3. Principles of International Law	2	......	22	27
Jones	3A. The Monroe Doctrine	1	......	......	12
Jones	4. History of International Law	2	......	8	7
Jones	5. Roman Law	4	......	26	30
Jones	7. Principles of Jurisprudence	4	......	33	22
	HISTORY AND POLITICAL SCIENCE.				
Plehn; Leach; Day	1. History of Europe during the Middle Ages	4	......	184	150
Bacon; Leach	2. Constitutional History of England	4	......	178	122

ENROLLMENT IN THE COURSES OF INSTRUCTION—Continued.

Instructor.	Title of Course.	No. of Hours a Week.		No. of Students in Attendance.	
		One Term	Two Terms	1894–95	1895–96
Bacon	3. History of Europe from the Reformation to the French Revolution	4	------	98	113
Bacon	4. Political History of the Nineteenth Century	4	------	97	90
Hayne	5. History of the United States; general view	4	------	43	59
Haynes	6. History of the United States; critical study of special topics	4	------	34	
Plehn; Haynes	7. Elementary Political Economy	4	------	58	96
Bacon	8. Comparative Constitutional Law	4	------	34	40
Moses	9. Spanish-American History and Institutions	2	------	22	39
Day	10. History of Greece; political, with especial reference to economic and constitutional	4	------	------	25
Day	11. History of Rome; political, with especial reference to economic and constitutional	4	------	------	16
Plehn	12. Economic History	4	------	49	35
Plehn	13. Local Government and Administration; comparative study, etc.	4	------	------	39
Plehn	14. Finance and Taxation	4	------	24	41
Moses	15. Economic Theory	4	------	40	15
Moses	16. History of Political Theories	4	------	23	14
Moses Moses	17. 22. } Political Science	2	------	5	11
Haynes	18. Social Conditions	4	------	16	------
Moses	18. Theories of Social Progress	2	------	------	2
Bacon	21. The History of the Christian Church	2	------	------	4
Plehn	22. Statistics; History, Theory, and Methods	2	------	------	10
	SEMITIC LANGUAGES.				
Voorsanger	1. Hebrew. Elementary	------	2	7	9
Voorsanger	2. Hebrew. Advanced Course	------	2	——	2
Voorsanger	3. Aramaic. Introductory Course	1	------	------	------
	CLASSICAL PHILOLOGY.				
Flagg	1. Introductory Course	1	------	53	------
Flagg	2. Studies in Greek History	------	1	17	------
Flagg	3. Studies in Roman History	------	1	------	33
G. M. Richardson	4. Classical Archæology, I. The Private Life of the Ancient Greeks	------	2	------	5
G. M. Richardson	5. The Private Life of the Ancient Romans	2	------	3	------
G. M. Richardson	5. Classical Archæology, II. Introduction to Greek Sculpture	2	------	------	5
G. M. Richardson	8. Classical Archæology, V. Topography and Monuments of Ancient Rome	2	------	------	9
	GREEK.				
Flagg	1. Twelve books of Homer	3	------	53	44
Clapp	2. Two books of Herodotus	3	------	40	------
Clapp	2. Herodotus and Plato's Apology	3	------	40	40
Clapp	3. Plato and Greek Composition	1	------	25	14
Clapp	4. Introduction to Greek Tragedy	3	------	22	27
Clapp	5. The Greek Drama: Continued	3	------	20	25
Flagg	6. The Sixth and Seventh Books of Thucydides	2	------	6	------
G. M. Richardson	6. The Protagoras of Plato	1	------	------	13
G. M. Richardson	7. The Greek Lyric Poets	1	------	------	6
Clapp	8. Sophocles and Euripides	2	------	9	------
G. M. Richardson	10. Theocritus. (*See Course 20, Latin.*)				

ENROLLMENT IN THE COURSES OF INSTRUCTION—Continued.

Instructor.	Title of Course.	No. of Hours a Week.		No. of Students in Attendance.	
		One Term	Two Terms	1894–95	1895–96
Flagg	10. Selections from the Attic Orators	2			8
Clapp	11. Greek Testament; a purely Philological Study, etc.	2		8	
Clapp	11. Sophocles	2			10
Clapp	12. Demosthenes	2			10
Flagg	13. Æschylus	2			10
	19. Theocritus. (*See Course 32, in Latin.*)				
Clapp	22. Greek Seminary: philological investigation		3	10	
Clapp; Flagg	23. Readings from Greek authors			—	—
Clapp	30. The Republic of Plato		4		8
Flagg	31. Sophocles. Plays and Fragments			—	—
Clapp	34. Greek Seminary			—	
	LATIN.				
L. J. Richardson	1. Cicero and Nepos	3		102	
Price; Pitcher	1. Cicero. Roman Life from the Sources	3			117
Flagg; L. J. Richardson	2. Quintus Curtius; Plautus and Terence	3		80	
Price; Pitcher	2. Plautus and Terence	3			100
L. J. Richardson	3. Livy and Latin Composition		1	61	
Price; Pitcher	3. Latin Composition, I; prose writing based on Cicero and Livy		1		109
Flagg; L. J. Richardson	4. The Odes and Epodes of Horace	3		51	
Merrill; Graves	4. Latin Composition, II; writing Latin in the style of Cicero		1		45
L. J. Richardson	5. Selected Letters of Cicero and Pliny	3		36	
Flagg; Price	5. Horace. The Odes and Epodes	2			68
Merrill	6. Latin Composition		1	10	
G. M. Richardson	7. The Pharsalia of Lucan	1		8	41
G. M. Richardson	8. The Fasti of Ovid; Roman Mythology	2		9	
Price	8. Selected Letters of Cicero and Pliny	2			41
Merrill	9. Catullus. Ovid, Amores, at sight	2			45
Merrill	10. The Epistles of Horace	2		7	
G. M. Richardson	11. Moral Essays of Seneca	1		3	
Flagg	12. Latin Composition, III. Extended idiom; translation of English masterpieces		1		6
G. M. Richardson	13. Georgics of Virgil	1		2	
G. M. Richardson	13. Latin Composition, IV. Continuation of Course 12		1		4
G. M. Richardson	14. The Pharsalia of Lucan; lectures, with translation and exegesis	1			5
Merrill	15. The Annals of Tacitus	2		—	
Merrill	16. Patristic Latin. Tertullian and the Hymn Writers	2		10	
G. M. Richardson	17. Advanced Latin Composition		1	13	
Flagg	18. Lucretius and Virgil	2		—	
Merrill	18. Tacitus, Histories. Suetonius	2			30
Merrill	19. Patristic Latin. Augustine and the Hymn Writers	3			17
G. M. Richardson	20. Greek and Roman Bucolic Poetry	3		2	
G. M. Richardson	21. Roman Satire	3		1	
Merrill	23. Latin Seminary		3	3	
Merrill	24. Early Latin	2		24	
Merrill	24. Early Latin	3			19
G. M. Richardson	31. Roman Satire	3			3
Merrill	34. Latin Seminary		3		6
Merrill	35. Teachers' Training Course	2			4
Flagg	40. Readings from Latin Authors			—	—

ENROLLMENT IN THE COURSES OF INSTRUCTION—Continued.

Instructor.	Title of Course.	No. of Hours a Week.		No. of Students in Attendance.	
		One Term	Two Terms	1894–95	1895–96
	ENGLISH.				
Lange; Armes; Syle; Sanford; McGilvary	1. (*a*) Types of English Prose Style	------	4	382	------
Armes; Syle; Sanford; McGilvary	(*b*) Supplementary Reading	------	1	368	------
Armes; Syle; Sanford; Hart	1. Types of English Prose Style	------	3	------	397
Armes	2. Practical Rhetoric	3	------	29	------
Bradley; Armes	2. General History of English Literature; synoptical view	------	3	------	174
Armes	3. English Masterpieces	3	------	38	------
Syle	3. Composition and Reading	------	2	------	43
Bradley	4. General History of English Literature	------	3	95	------
Sanford	4. Short Course in the History of English Literature	------	2	------	30
Gayley	5. Argumentation	2	------	16	------
Lange; Hart	5. (*a*) Elementary Old English	------	2	------	72
Lange	6. Exposition	2	------	34	43
Gayley	7. Forensics. Practice in debate, etc.	2	------	9	------
Gayley	7A. Argumentation. Analysis of Masterpieces, etc.	3	------	------	19
Gayley	7B. Forensics. Practice in debate, etc	2	------	------	12
Gayley; Lange	8. Poetics. A topical survey	2	------	40	60
Gayley	9. Problems of Literary Criticism. Seminary and lectures	3	------	33	41
Lange	10. (*a*) Old English. Elements of grammar; translation of prose	2	------	18	------
Lange	(*b*) Germanic Sources of English Life and Culture	1	------	25	------
Bradley	10. Frequent and Rapid Writing. Advanced course involving personal training	------	2	------	——
Lange	11. (*a*) Old English Poetry	------	------	------	------
Lange	(*b*) Introduction to Germanic Philology. Lectures	3	------	13	------
Bradley	12. The English Language and Grammar	3	------	16	------
Lange	12. Advanced Old English	2	------	8	8
Lange	13. Chaucer. A minute study, etc. Seminary	2	------	9	6
Bradley	14. English Grammar	2	------	------	10
Sanford	15. Spenser and the Spenserians	2	------	5	17
Armes	16. History of the Drama—				
	(*a*) Introduction to the English Drama	2	------	31	25
	(*b*) The History of the English Drama	2	------	16	23
Gayley	17. Shakespeare—				
	(*a*) General Criticism of Twelve Plays	2	------	36	38
	(*b*) The Construction of Shakesperian Comedy	2	------	18	17
Bradley	18. Milton	2	------	13	16
Syle	19. English Literature of the Eighteenth Century—				
	(*a*) Restoration Comedy, etc.	2	------	12	22
	(*b*) The Novelists, the Historians, etc.	2	------	10	21
Sanford	20. English Romanticism	2	------	11	14
Gayley	22. Browning	2	------	18	------
Gayley	22. Tennyson and Browning	3	------	------	28
Gayley	23. English Comedy	2	------	18	------
Bradley	23. Study of an Author. Entire production of some selected author, etc.	2	------	2	2

ENROLLMENT IN THE COURSES OF INSTRUCTION—Continued.

Instructor.	Title of Course.	No. of Hours a Week.		No. of Students in Attendance.	
		One Term	Two Terms	1894–95	1895–96
Bradley	24. The Essay	------	2	5	11
Lange	24. Old Icelandic	------	2	------	1
Lange	25. English Philology. Old Icelandic	2	------	3	------
Lange	25. Phonology. First Modern English	------	2	------	1
Gayley	30. The History of Æsthetic Theory. Seminary—				
	(*b*) The Middle Ages, the Renaissance and Modern Æsthetics	------	2	17	------
	(*c*) The Æsthetic bases of English Criticism in the Nineteenth Century, etc.	------	2	------	9
------	31. Special Study	------	------	------	------
Gayley	31. English Comedy—Investigation	------	2	------	2
	GERMAN.				
Putzker; Senger	1. Introductory Course	------	4	119	169
Lange	1A. German Prose	------	4	------	33
Putzker	2. Schiller	------	4	82	91
Senger	3. Scientific German	------	3	13	11
Senger	4. Goethe	------	3	26	46
Putzker	5. Lessing	------	3	15	17
Senger	6. Composition and Conversation	------	2	4	8
Senger	7. Middle High German and Old High German	------	------	2	17
Senger	8. Gothic	2	------	3	4
Putzker	9. German Literature. Graduate Course	------	2½	------	------
Putzker	10. German Lyric Poets of the Nineteenth Century	------	3	------	11
Senger	12. Historical German Grammar	2	------	------	4
Ongerth	German Colloquia	------	------		
	ROMANCE LANGUAGES.				
Paget; Howard; Faucheux	1. Introductory Course. French Grammar and Reader	------	4	169	175
Paget; Faucheux	2. Le Roi des Montagnes	------	2	148	------
Faucheux	2. Scientific and Literary French Prose	------	2	------	49
Howard; Faucheux	3. Grammar and Prose	------	3	21	------
Howard; Faucheux	3. Prosper Mérimée's Colomba	------	1	------	130
Paget; Faucheux	4. Le Trois Mousquetaires	------	1	73	------
Paget	4. French Drama	------	2	------	124
Paget; Huntington	5. French Drama	------	2	73	------
Howard	5. French Composition	------	1	25	16
Faucheux	6. Selections from the Poets of the Romantic School	------	2	------	26
Paget	7. Victor Hugo's Prose	------	2	40	------
Faucheux	7. An Elementary Course in the History of French Literature	------	2	------	10
Faucheux	8. Lamartine's Poetry	------	2	13	------
Huntington	9. General Survey of French Literature	------	2	21	------
Paget	12. Literature of the Eighteenth century. Lectures	------	1	------	43
Paget	13. Literature of the second half of the Seventeenth century. Lectures	------	1	28	------
Paget	13. Victor Hugo's Prose	------	2	------	56
Faucheux; Huntington	14. Victor Hugo's Poetry	------	2	15	13
Paget	15. The Romantic School. Lectures	------	1	------	23
Paget	18. Poets and Novelists of the Nineteenth Century. Lectures	------	1	18	------
Howard	18. Grammar. Selections from Gil Blas, etc.	------	3	------	34

ENROLLMENT IN THE COURSES OF INSTRUCTION—Continued.

Instructor.	Title of Course.	No. of Hours a Week.		No. of Students in Attendance.	
		One Term	Two Terms	1894–95	1895–96
Howard	19. Grammar and Selections from Gil Blas	3	------	21	------
Howard	19. Spanish Drama	------	3	------	15
Howard	20. Modern Spanish Novels	3	------	16	------
Paget	20. Don Quijote; critical reading	------	1	------	14
Huntington	21. Don Quijote	------	3	8	------
Howard; Huntington	21. Grammar and Modern Italian	------	3	3	5
Paget	23. Dante's La Divina Commedia	------	2	1	------
Paget	24. Dante's La Divina Commedia. Purgatoris	------	2	------	5
Faucheux	25. Old French	------	2	------	6
Paget	26. Comparative Syntax and Study of Old Texts continued	------	2	3	------
Paget	26. A Comparative Study of the principal romance languages (*a*) Phonetics. (*b*) Morphology. (*c*) Comparative Syntax.	------	2	------	7
	DECORATIVE AND INDUSTRIAL ART.				
Ardley; Maybeck	1. Elementary Drawing	------	2	135	74
Ardley; Maybeck	2. Advanced Drawing—Study of the Antique in Crayon, Charcoal, etc.	------	2	30	29
Ardley; Maybeck	4. Ornamental Design	------	4	------	18
Ardley	5. Original Analysis	2	------	------	3
Ardley	6. Ancient Art and Historic Ornament	2	------	------	4
	MATHEMATICS.				
Stringham; Edwards; Haskell; Hengstler; Pierce; Wright	1. Algebra. The later chapters in elementary algebra	------	2	234	376
Stringham	2. The Language and Methods of Mathematics	------	2	------	48
Edwards; Haskell; Pierce; Wright; Saph	3. Elements of Analysis	------	5	79	138
Haskell; Wright; Saph; Edwards; Hengstler; Pierce; Saph	4. Plane Trigonometry	3	------	73	87
Haskell; Hengstler; Edwards	5. Plane and Analytic Geometry	3	------	82	95
Edwards; Pierce	6. Solid and Spherical Geometry. The Fundamental Propositions, etc.	2	------	150	102
Pierce	7. Spherical Trigonometry	1	------	31	41
Stringham; Haskell; Hengstler	9. Differential and Integral Calculus	------	3	48	108
Edwards	10. Problems in the Differential and and Integral Calculus	2	------	3	35
Haskell	11. Determinants and Theory of Equations	3	------	1	------
Haskell	12. Projective Geometry	3	------	4	------
Hengstler	12. Propædeutic to the Higher Analysis	------	2	27	5
Pierce	13. Conic Sections, Advanced Course	------	3	5	------
Edwards	13. Principles and Methods of Instruction	------	1	32	40
Pierce	15. Analytic Projective Geometry	------	3	------	7
Hengstler	17. History of Mathematics	------	2	12	10
Stringham	18. Logic of Mathematics	2	------	6	10
Edwards	19. Differential Equations	------	3	28	25
Stringham	21. Theory of Functions of Real Variables	------	2	10	5
Haskell	22. Theory of Functions of a Complex Variable	3	------	------	8

ENROLLMENT IN THE COURSES OF INSTRUCTION—Continued.

Instructor.	Title of Course.	No. of Hours a Week.		No. of Students in Attendance.	
		One Term	Two Terms	1894–95	1895–96
Haskell	23. Theory of Algebraic Forms	4	------	3	------
Haskell	24. Higher Plane Curves	4	------	3	------
Pierce	26. Quaternions; elementary presentation of the principles	------	3	1	------
Stringham	27. Absolute Geometry (Given in connection with course 34.)	------	2	6	------
Haskell	30. Theory of Numbers	4	------	1	------
Haskell	31. Theory of Substitutions	------	2	------	4
Stringham	32. Partial Differential Equations	3	------	------	9
Stringham	34. Mathematical Seminary	------	------	------	—
	PHYSICS.				
Whiting; Sones	1. Elementary Physics; lectures and laboratory	3	------	192	------
Lewis; Alexander	1. Elementary Physics; lectures and laboratory	------	3	------	155
Whiting; Sones	2. Elementary Physics; continuation of Course 1	3	------	157	------
Lewis	2. General Physics; lectures with experimental illustration	------	3	------	107
Whiting	3. General Physics; lectures with experimental illustration	3	------	75	------
Drew	3. Physical Measurement; laboratory	------	2	------	90
Whiting	4. General Physics; continuation of Course 3	3	------	52	------
Slate	5. General Physics; lectures with experimental illustration	------	3	26	------
Slate; Raymond	5. Analytic Mechanics; lectures	------	4	------	40
Drew	6. Physical Measurement; laboratory—				
	(*a*) Measurements in Mechanics, Heat, Light, etc.	1½	------	40	------
	(*b*) Measurements in Chemical Physics	1½	------	12	------
	(*c*) Measurements supplementary to (*a*)	1½	------	12	------
Raymond	6. Harmonic Motion	2	------	------	2
Slate; Raymond	7. Analytic Mechanics; lectures	------	4	44	------
Raymond	7. Absolute Electrical Measurements; lectures and laboratory	3	------	------	21
Raymond	8. Harmonic Motion	2	------	3	------
Lewis	8. Spectroscopy; lectures	2	------	------	8
Raymond	9. Absolute Electrical Measurements; lectures and laboratory	3	------	17	------
Drew	9. Light. Special reference to optical instruments; lectures	2	------	4	4
Raymond	12. Electricity. Elementary theory	2	------	2	------
Drew	12. Heat as a Form of Energy—Experimental lectures	2	------	------	2
Raymond	14. Advanced Physical Measurement	3	------	------	7
Raymond	15. Physical Optics; laboratory	2	------	3	------
Slate	15. Dynamics of Rotation	------	2	------	7
Raymond	16. Advanced Physical Measurement	3	------	12	------
Raymond	17. Special Advanced Study and Research; laboratory	------	------	—	------
	17. (*a*) Recent Advances in the theory of Electrolysis	------	2	------	1
	(*b*) Stresses and Strains in Elastic Solids	------	2	------	2
Slate	18. Readings and Discussions	------	4	2	------

ENROLLMENT IN THE COURSES OF INSTRUCTION—Continued.

Instructor.	Title of Course.	No. of Hours a Week.		No. of Students in Attendance.	
		One Term	Two Terms	1894–95	1895–96
	ASTRONOMY.				
Leuschner	1. Modern Astronomy. An introductory course	3	------	14	------
Leuschner	1. Modern Astronomy—				
	(*a*) An introductory course	2	------	------	23
	(*b*) Progress in Astronomy through modern methods	2	------	------	27
Leuschner; Seares	2. Supplement to Course 1. Practice in observing	------	2	13	9
Leuschner	3. General Astronomy	3	------	------	12
Leuschner; Seares	4. Practical Astronomy and Navigation; continuation of course 3—				
	(*a*) Astronomy	3	------	5	12
	(*b*) Practical work in observatory	------	2	6	5
Leuschner	6. Theoretical Astronomy	------	4	4	3
Leuschner	7. Method of Least Squares	2	------	18	------
Leuschner	10. Summer School; continuation of Course 3	------	------	—	—
Leuschner	11. Advanced Practical Astronomy	------	1	------	6
Leuschner	12. Higher Theoretical Astronomy	------	2	------	4
	CHEMISTRY.				
Rising	1. Inorganic Chemistry: The non-metals	3	------	218	163
Rising	2. Inorganic Chemistry: The metals	2	------	188	------
Rising	2. Inorganic Chemistry: The metals	3	------	------	149
Sharwood; Lenher	3. Laboratory: Experiments	2	------	120	137
Sharwood; Lenher	4. Laboratory: Qualitative Analysis	2	------	120	120
Rising; Lenher; O'Neill; Blasdale	5. Laboratory: Quantitative Analysis. Gravimetric	3	------	21	41
Rising; O'Neill; Blasdale	6. Laboratory: Quantitative Analysis. Volumetric	3	------	20	43
O'Neill	7. Organic Chemistry	4	------	13	------
Rising	7. Inorganic Chemistry	2	------	------	18
O'Neill; Norris	8. Laboratory: Organic Chemistry. Supplementary to Course 7	4	------	18	------
O'Neill	8. Organic Chemistry. Elementary introductory course	2	------	------	23
Rising	9. Theoretical Chemistry	------	2	9	------
O'Neill	9. Organic Chemistry. Advanced	3	------	------	13
Rising; O'Neill	10. Advanced Laboratory	4,5,6	------	9	------
O'Neill; Norris	10. Laboratory: Organic. Supplementary to Courses 8 and 9	3	------	------	8
Rising	11. Theoretical Chemistry	3	------	------	8
Rising	11A. Theoretical Chemistry	------	2	------	14
O'Neill	16. Physiological Chemistry	2	------	1	------
Blasdale	16. Ore Analysis	2	------	------	9
O'Neill	17. Toxicology; lectures and laboratory	2	------	13	------
Rising; Lenher	17. Analysis of Iron, Steel, and Alloys	1	------	2	2
O'Neill	18. Physiological Chemistry Lectures	2	------	------	17
O'Neill; Blasdale	19. Water Analysis	1	------	21	------
O'Neill	19. Laboratory. Urine Analysis, etc.	1	------	------	11
O'Neill	21. History of Chemistry	1	------	7	------
O'Neill; Blasdale	21. Water Analysis	1	------	------	9
O'Neill	24. Selected Topics in Organic Chemistry	1	------	------	11
Rising	25. Explosives	2	------	------	9
Sharwood	26. Rare Metals; lectures and discussions	1	------	------	2
Sharwood	27. Chemistry of Pure Metals	1	------	6	------
Rising	28. Teachers' Course	4	------	------	3

Enrollment in the Courses of Instruction—Continued.

Instructor.	Title of Course.	No. of Hours a Week.		No. of Students in Attendance.	
		One Term	Two Terms	1894–95	1895–96
	Botany.				
Howe	1. Vegetal Structure and Morphology	3	------	61	81
Greene	2. Systematic and Economic Botany	3	------	41	------
Jepson	2. General Plant Morphology	3	------	------	53
Greene; Jepson	3. Advanced Systematic Botany	------	3	8	------
Jepson	3. Systematic Studies among the Angiosperms	3	------	------	6
Greene; Jepson	4. Medical Botany	------	3	4	------
Howe	5. Cryptogamic Botany	------	3	10	9
Howe	6. Vegetable Histology	2	------	7	------
Setchell; Howe	6. Vegetable Histology	3	------	------	8
Greene	7. The Phanerogamic Natural Orders	------	3	1	2
Davy	7A. Economic (Agricultural and Commercial) Botany	2	------	8	------
Greene	8. History of Botany	—	—	3	------
Davy	8. Economic Botany (Agricultural, Commercial, and Medical)	2	------	------	7
Greene	9. Graduate	—	—	1	------
Howe	9. Systematic Critical Studies in Cryptogamous Plants	------	2	------	4
Setchell	10. Vegetable Cytology and Microtechnique	3	------	------	4
Greene	11. History of Botany	------	------	------	2
	Zoölogy.				
Le Conte	1. Comparative Zoölogy	------	2	135	220
Johnson; Holmes	2. Morphology of Invertebrates	3	------	24	------
Ritter; Torrey	2. Morphology of Invertebrates	4	------	------	34
Johnson; Holmes	3. Morphology of Lower Vertebrates	3	------	24	------
Johnson	3. Morphology of the Lower Vertebrates	4	------	------	33
------	4. Structure and Affinities of the Mammalia	2	------	------	9
Johnson; Ritter	5. Microscopical Anatomy	5	------	13	15
Johnson	6. Embryology	5	------	10	17
Holmes; Johnson	7. Systematic Zoölogy	2	------	5	2
Johnson	8. Graduate Zoölogy	------	------	7	------
------	8. Seaside Laboratory	------	------	------	------
Ritter	12. Zoölogical Seminary	------	1	------	4
	Geology.				
Le Conte	1. General Geology	------	3	155	145
Lawson	2. Field Geology	------	2	6	5
Lawson	3. Petrography	------	1	5	6
Lawson	4. Petrographical Laboratory	------	1	5	6
Lawson	5. Graduate Course: Inorganic Geology	------	------	2	------
Merriam	5. Elementary Palæontology. Lecture and Laboratory	------	3	------	2
Merriam	6. General Palæontology	------	2	6	------
Merriam	6. Advanced Palæontology	2	------	------	5
Merriam	7. Advanced Palæontological Laboratory	------	2	------	3
Lawson	8. Graduate Course: Inorganic Geology	------	------	------	2
	Mineralogy.				
Ransome	1. Mineralogical Laboratory	------	2⅔	32	48
Lawson	2. Crystallography—				
	(*a*) The Morphology of Minerals	2	------	6	18
	(*b*) Crystallographic Laboratory	1	------	6	16

ENROLLMENT IN THE COURSES OF INSTRUCTION—Continued.

Instructor.	Title of Course.	No. of Hours a Week.		No. of Students in Attendance.	
		One Term	Two Terms	1894–95	1895–96
Lawson	3. Descriptive Mineralogy and Mineralogical Laboratory—				
	(*a*) Descriptive Mineralogy	2	------	4	15
	(*b*) Inspection of Minerals	1	------	4	15
Lawson	4. Graduate Course	------	------	1	------
	MECHANICAL ENGINEERING.				
Slate	1. Analytic Mechanics	------	4	37	40
Hesse	2. Hydrodynamics	3	------	17	19
Hesse	3. Hydraulics and Hydraulic Machinery	3	------	8	12
Le Conte	4. Kinematics—				
	First Term	2	------	8	13
	Second Term	3	------	9	12
Hesse	5. Thermodynamics	3	------	8	10
Hesse	6. Dynamics of Heat Engines	3	------	8	12
Hesse; Cory; Le Conte	7. Mechanical Laboratory. Experimental Engineering	------	2	8	------
Chesebrough	8. Mechanical Practice	------	2	27	64
Chesebrough	9. Mechanical Practice	------	2	25	28
Cory	10. Electrical Machinery	4	------	6	------
Cory	11. Electrical Engineering—				
	(*a*) Alternating Currents and Alternating Current Machinery	4	------	7	------
Cory	11. Electrical Engineering—				
	(*a*) Alternating Currents, etc. (*b*) Electricity in Engineering and Principles of Electrical Installation	----	4	------	13
	(*c*) Electrical Laboratory and Designing	------	2	------	11
	CIVIL ENGINEERING.				
Randall; Fogg	1. (*a*) Surveying Lectures—				
	First term	2	------	61	79
	Second term	1	------	53	79
Randall	(*b*) Field Practice and Mapping	------	3	49	------
Randall; Fogg	(*b*) Field Practice and Mapping—				
	First Term	1	------	------	68
	Second Term	2	------	------	68
Randall	2. (*a*) Railway, Highway, and Canal Surveying	3	------	8	8
Randall; Fogg	(*b*) Railroad Field Practice and Mapping	2	------	19	14
Randall	3. Summer School in Field Practice and Mapping	------	------	17	22
Randall	4. Railroad Economics	3	------	------	9
Randall	6. Highways and Pavements	2	------	5	12
	7. Framed Structures—				
Randall	(*a*) Computation of stresses, etc.	3	------	12	13
Randall	(*b*) Swing, suspension, cantilever bridges, etc.	3	------	6	8
	8. Strength of Materials—				
Soulé	(*a*) Properties and Characteristics of materials used in construction	4	------	29	28
Soulé	(*b*) Civil Engineering Laboratory	1	------	8	3
Soulé	9. Sewer Systems	2	------	9	7
Soulé	10. Irrigation and Drainage	2	------	9	6
Soulé	11. Water Supply Systems	3	------	6	3
Soulé	12. Construction of Dams	3	------	5	5
Soulé	13. Foundations of Structures	2	------	6	8
	MINING AND METALLURGY.				
Christy	1. Lectures on Mining	4	------	6	5
Christy	2. Lectures on Mining	4	------	7	5

ENROLLMENT IN THE COURSES OF INSTRUCTION—Continued.

Instructor.	Title of Course.	No. of Hours a Week.		No. of Students in Attendance.	
		One Term	Two Terms	1894–95	1895–96
Christy	3. Mining Laboratory	2	......	3	10
Christy	4. Summer School of Practical Mining	......	......	——	——
Christy	5. Metallurgy: Structural Metals and Fuels	2	......	25	38
Christy	6. Metallurgy: General Methods of crushing ores, etc.	2	......	7	21
Christy	7. Assaying. Lectures and laboratory	......	2	9	......
Christy; Simonds	7. (*a*) Assaying. Lectures and laboratory. Gold and silver ores	2	......	......	18
Christy; Simonds	(*b*) Assaying. Lectures and laboratory. Ores of lead, antimony, tin, etc.	2	......	......	3
Christy	8. Metallurgy of Gold and Silver. Lectures	2	......	......	7
Christy; Hersam	9. Metallurgical Laboratory, supplementary to Course 8	2	......	3	4
Christy; Hersam; Simonds	10. Metallurgical Laboratory; mill work	2	......	5	6
Christy	11. Metallurgy of Lead, Copper, and Quicksilver	2	......	......	9
Christy	12. Ore Dressing	......	2	4	......
	INDUSTRIAL DRAWING AND DECORATIVE ART.				
Ardley; Maybeck	1. Elementary Drawing	2	......	135	......
Kower; Maybeck	2. Descriptive Geometry	......	4	90	......
Ardley; Maybeck	3. Topographical and Structural Drawing	1	......	26	......
Kower	4. Mechanical Drawing	2	......	28	......
Kower	5. Mechanical Drawing. Continuation of Course 4	2 2	....	35 13	....
Kower	6. Graphostatics	2	......	35	......
Kower	7. Construction; including designing of engineering structures—				
	College of Civil Engineering	......	6	6	......
	College of Mechanics	......	4	8	......
Ardley	8. Drawing from casts in crayon and charcoal	......	......	——	......
Ardley	9. Brush work	......	......	——	......
Ardley	10. Architectural Free Hand Work	......	......	——	......
Ardley	11. Landscape—Outdoor work in black and white and water colors	......	......	——	......
Ardley	12. Decorative and Industrial Art	......	......	——	......
	INSTRUMENTAL DRAWING AND ENGINEERING DESIGN.				
Ardley; Maybeck	1. Instrumental Drawing	2	......	......	74
Kower; Maybeck	2. Descriptive Geometry	......	2	......	70
Fogg	3. Topographical and Structural Drawing	1	......	......	14
Kower	4 Mechanical Drawing	2	......	......	36
Kower	5. Mechanical Drawing. Contination of Course 4	2	......	......	17
Kower	6. Graphostatics	2	......	......	38
Kower	7. Construction. Designing of mechanical apparatus, etc.	2	......	......	4
Randall	8. Construction; including designing of engineering structures	......	3	......	11
	AGRICULTURE, HORTICULTURE, AND ENTOMOLOGY.				
Hilgard; Loughridge	1. General Course in Agricultural Chemistry—				
	(*a*) Chemistry of plants, and their products, etc	3	......	12	8

ENROLLMENT IN THE COURSES OF INSTRUCTION—Continued.

Instructor.	Title of Course.	No. of Hours a Week.		No. of Students in Attendance.	
		One Term	Two Terms	1894-95	1895-96
Hilgard; Loughridge	(*b*) Chemistry and physics of soils, etc	3	------	7	8
Hayne; Colby; Bioletti	2. Vinification	2	------	——	3
Jaffa; Colby; Hayne	3. Agricultural and Viticultural Laboratory	------	8 or 10	4	8
Jaffa	3. (*a*) Analysis of Forage Plants, Hays, and Mill Stuffs	3	------	------	5
Wickson	4. General Course in Agriculture and Horticulture	------	3	7	6
Hayne	5. Viticulture; Olive Culture	2	------	7	5
Woodworth	7. Elementary and Economic Entomology	2 or 3	-- ---	9	
Woodworth	8. Apiculture. Lectures and laboratory	2 or 3	------	5	1
Woodworth	9. Parasitic Plant Diseases	2	------	5	7
Woodworth	10. Systematic Entomology	3	------	——	-----
Woodworth	11. Structural Entomology; an advanced course of lectures	3	------	4	-----
Woodworth	12. Entomological Laboratory	------	4 or 6	3	7
Wickson	13. Seminary Course in Agricultural Literature	------	1	11	13
Hilgard; Loughridge	14. Relation of Soil and Agriculture to Climatic Conditions	2	-----	------	5
	PHYSICAL CULTURE.				
Magee	1. Elementary Course; 3 half-hours, both terms	------	------	297	199
Magee	2. Advanced Course; 5 half-hours, both terms	------	------	——	------
Magee	2. Advanced Course; 3 half-hours, both terms	------	------	——	223
Magee	3. Course for Young Women; 10 hours, both terms	------	------	49	190
	MILITARY SCIENCE AND TACTICS.				
Winn	1. Practical Course. Infantry and artillery exercises, signaling, and band practice	------	2	391	552
Winn	2. Theoretical Course; lectures and recitations	------	1	72	75
	THE LIBRARY.				
Rowell	The Use of the Library: A short course of lectures at the opening of each Academic year	------	--- --	——	——

TOTAL NUMBER OF COURSES.

1894-95	295
1895-96	313

During the year 1894-95 the following University Extension Courses were given:

PEDAGOGY. The Development of Character. Six lectures, by Assistant Professor Bailey, at the Mark Hopkins Institute of Art.

HISTORY AND POLITICAL SCIENCE. Napoleon and his Epoch. Six lectures, by Associate Professor Bacon, at the Young Men's Christian Association's Auditorium, San Francisco.

HISTORY AND POLITICAL SCIENCE. Economic Questions of the Day. Twelve exercises, under the direction of Assistant Professor Plehn, at the Hall of the Starr King Fraternity, in Oakland.

History and Political Science. Under the direction of Professor Moses, with the coöperation of the Departments of History and Political Science and Jurisprudence, the Political Science Club held fortnightly meetings throughout the first term.

Greek. Reading and Translation of the Oedipus Tyrannus of Sophocles, with introductory matter and explanatory comment. Seven exercises, under the direction of Professor Clapp, at the Mark Hopkins Institute of Art.

Latin. Martial; Translation and Exegesis. Six exercises, under the direction of Professor Merrill, at the Mark Hopkins Institute of Art.

English. Poets of the Nineteenth Century. Six lectures, by Mr. Armes, at the Hall of the Ebell Society, Oakland.

German. The Classic Period of German Literature, 1748–1832. Six lectures, by Assistant Professor Senger, at the Mark Hopkins Institute of Art.

Geology. The Phenomena of Glacial Action. Three lectures, by Professor Le Conte, at the California Academy of Sciences.

Geology. The Glacial Epoch in California. Three lectures by Professor Le Conte, at the Young Men's Christian Association's Auditorium, San Francisco.

Geology. The Phenomena of Glacial Action. Three lectures, by Professor Le Conte, at the Young Men's Christian Association's Hall, Oakland.

Popular Scientific Lectures by Professor Hilgard on Drinking and Irrigating Waters of California, by Associate Professor Ardley on Decorating and Designing, by Associate Professor Bacon on the Influence of Invention upon History, by Assistant Professor Cory on Electricity, and by Professor Soulé on Engineering, were delivered at the Mechanics' Institute, San Francisco, Saturday evenings, from January 12th to April 13th.

During the year 1895–96 the following University Extension Courses were given:

Pedagogy. The Foundations of Pedagogical Method. Four lectures, by Assistant Professor Bailey, at the Mark Hopkins Institute of Art.

German. The Poems of Schiller. Six critical expository readings, by Professor Putzker, at the Mark Hopkins Institute of Art.

German. Goethe's Faust. Six critical expository readings, by Professor Putzker, at the Mark Hopkins Institute of Art.

Decorative and Industrial Art. The Origin and Evolution of Art. Five illustrated lectures, by Associate Professor Ardley, at the Young Men's Christian Association's Auditorium, San Francisco.

Mathematics. Some Historical Problems of Mathematics. Six lectures, by Associate Professor Haskell, at the Mark Hopkins Institute of Art.

Physiology. Hypnotism. Six lectures, by Professor D'Ancona, at the Auditorium of the College of Dentistry.

Under the auspices of the University, two lectures on Etching and Etchers were delivered in the Auditorium of the California Academy of Sciences, by Mr. Frederick Keppel.

The enrollment in the Summer School Courses since their organization in 1891 has been as follows:

	1891.	1892.	1893.	1894.	1895.	1896.
Chemistry	6	25	16	19	37	56
Physics	--------	15	20	--------	30	51

The following brief recapitulation of the number of students in attendance, the number of courses given, and the number of persons engaged in the work of instruction during the past five years, reveals an abnormally increasing demand on the energies of the teaching staff in Berkeley. This demand has already passed the point of safety for the best interests of the University:

	1891–92.	1892–93.	1893–94.	1894–95.	1895–96.	Approximate Increase.
Number of Students	547	650	815	1,124	1,336	144%
Graduates	37	47	64	100	118	219
Undergraduates	510	603	751	1,024	1,218	139
Number of Courses given*	158	186	225	295	313	98
Staff of Instruction	60	77	88	90	94	57%
Instructors, including Professors	46	55	58	66	70	52
Assistants	14	22	30	24	24	71

* Exclusive of University Extension Courses.

The column of percentages in this table furnishes all the comment that need be made upon this phase of our overcrowded condition. The further increase in the number of students which is already upon us (about two hundred at the present writing, September, 1896), without *any* present increase in the number of instructors, will make the work of the coming year very difficult of successful management, and will tax the resources of nearly every department to the utmost. The limit has really been reached, and the cords will snap if subjected to any greater strain.

The new grouping of studies requisite for the Bachelor's degree in the College of Letters, and in the recently organized Colleges of Social Sciences and Natural Sciences, has now been in effect for three years. This time is too short as a test of its entire efficiency for accomplishing its purpose, but at present writing every indication points to its success. As compared with our former programme it gives a larger freedom in choice of studies to the student, while, at the same time, insisting on a higher quality of scholarship, and it has greatly simplified the application of adequate criteria of fitness for graduation. The student may no longer attain to the Bachelor's degree by the accumulation of the requisite number of scholarship credits in merely elementary studies, as was sometimes possible in former years.

The present Seniors are the first class of students who began their College career under the new grouping, so that up to the present time all who have graduated since the reorganization, having first adjusted their plans to the old programme, were obliged to make many readjustments in order to conform to the new. Comparatively few completed schedules for the Bachelor's degree, therefore, exemplify in all particulars the practical working out of the new plan. In order, however, to give, as early as possible, a tangible account of how it adjusts itself to the various demands to be met, both of the student for freedom of choice and of the University for purposive study and adequate accomplishment, I present in this report four completed schedules of graduates of the present year, two for the degree of A.B., one for the degree of B.L., and one for the degree of B.S. The schedules had to be constructed in accordance with the following prescriptions:

A. PRESCRIBED STUDIES. Sixty-five units,* as distributed in the following table:

Studies.	College of Letters.	College of Social Sciences.	College of Natural Sciences.
1. English	8	10	10
2. Mathematics	10	10	10
3. Natural Sciences	10	12	26
4. French or German	14	--	14
5. † Latin, French, German, History	--	28	--
6. Latin	6	--	--
7. Greek	6	--	--
8. Greek or Latin, or both languages	6	--	--
9. Military Science	5	5	5
Total hours	65	65	65

*A unit is a credit of one hour of work per week for one term (half-year).

†Not less than two nor more than three of these subjects; but the French or German, if chosen, must be pursued two years.

B. GROUP ELECTIVES. Thirty units of advanced studies in one subject, or not more than two cognate subjects, chosen from one of the following groups:

1. Philosophy: either alone or together with one subject from Group 2, 3, 4, 5, or 6.
2. Economics and Politics (including History and Law).
3. The Semitic, Greek, Latin, French, Spanish, Italian, German, and English languages and literatures, or any other languages and literatures that may at any time be announced among the courses of instruction; Comparative Philology, Archæology, Art, etc.
4. Pedagogy.
5. Mathematics, Physics, Chemistry, Astronomy.
6. Physics, Chemistry, Geology (including Palæontology, Mineralogy, and Petrography), the Biological Sciences (including Botany and Zoölogy).

C. FREE ELECTIVES. Thirty units, chosen from the entire list of courses, subject, however, to any sequence of studies required and announced by any department.

Fifty units of the Prescribed Studies named above must be completed during the first two years; twelve units—six of a modern language and six of natural sciences—may be taken as late as the third year.

The choice of Group Electives may be announced at the beginning of any term after sixty units of work have been satisfactorily completed, but not later than the beginning of the Senior year. A statement of the courses permissible for Group Electives is made from year to year in the Announcement of Courses of Instruction.

Students who are excused from Military Service must add five to the thirty units of Free Electives.

The persons whose schedules are here presented are designated as Mr. A, Miss B, Miss C, and Mr. D.

MR. A.

College of Letters; Graduate of the Year 1896; Degree of A.B.

Credits for Entrance Requirements on Certificate from the Lowell High School of San Francisco: Elementary English, Algebra through quadratics, Plane Geometry, Government of the United States, Cæsar's Gallic War, Cicero's Orations against Catiline, Elementary Latin Composition, Virgil's Æneid, Cicero's Orations pro Archia Poeta and pro Lege Manilia, Latin at Sight, Advanced Latin Composition, Greek Grammar, Xenophon's Anabasis, Greek at Sight, Greek Composition, Homer's Iliad, Greek History, Roman History, Solid Geometry. (The last subject in excess of the requirements.)

Prescribed Studies.		Free Electives.		Group Electives.	
English:	Units.	*Mathematics and Physics:*	Units.	*Chemistry:*	Units.
Prose Style	8	Diff. and Int. Calculus	6	Quantitative Analysis	4
Mathematics:		Analytic Mechanics	4	Volumetric Analysis	3
Solid Geometry	2	Physical Laboratory	3	Organic Chemistry	4
Trigonometry	3	Physical Measurem't	4½	Organic Laboratory	3
Analytic Geometry	3	Spectroscopy	2	Explosives	2
Propædeutic to Anal.	3		—19½	Water Analysis	1
	—11	*Chemistry:*		Theoretical Chemistry	2
One unit in excess of requirement.		Qualitative Analysis	4	Advanced Laboratory	3
					—22
Natural Sciences:		*Mineralogy:*		*Geology:*	
Inorganic Chemistry	4	Crystallography	3	General Geology	6
General Physics	6	Laboratory	2⅔	Field Geology	2
	—10		— 5⅔		— 8
French:		*Greek:*			
Introductory Course	8	Herodotus	3		
	6	*English:*			
	—14	Themes	2		
Latin:					
	6				
Composition	2				
Private Life of the Romans	1				
	1				
	—10				
Greek	8				
Military Science and Tactics	5				
Total Prescribed Studies	66	Total Free Electives	34⅙	Total Group Electives	30
Total requirement for graduation	65	Total requirement for graduation	30		
In excess of requirement	1	In excess of requirem't	4⅙		

Miss B.

College of Letters; Graduate of the Year 1896; Degree of A.B.

Credits for Entrance Requirements on Certificate from the Alameda High School: Elementary English, Algebra through quadratics, Plane Geometry, Government of the United States, Cæsar's Gallic War, Cicero's Orations against Catiline, Elementary Latin Composition, Virgil's Æneid, Cicero's Orations pro Archia Poeta and pro Lege Manilia, Latin at Sight, Advanced Latin Composition, Greek Grammar, Xenophon's Anabasis, Greek at Sight, Greek Composition, Homer's Iliad, Greek History, Roman History.

Prescribed Studies.		Free Electives.		Group Electives.	
English:	Units.	*Hebrew:*	Units.	*Latin:*	Units.
Prose Style	6	Introductory and Advanced Courses	6	Ovid	2
Themes	2			Tacitus' Annals	2
	— 8	*Greek:*		St. Augustine	3
Mathematics:		Selections	8	Tacitus' History	2
Algebra	3	Composition	1	Tibullus and Propertius	3
Trigonometry	3	Thucydides	2		—12
Solid Geometry	2	Euripides	2	*German:*	
Analytic Geometry	3	Sophocles	2	Goethe	6
	—11	Demosthenes	2	Lessing	6
One unit in excess of requirement.			—17	XIXth Century Authors	6
Natural Sciences:		*Latin:*			—18
Zoölogy	4	Composition	2		
Geology	6	*English:*			
	—10	History of English Literature	6		
German:		*Pedagogy:*			
Introductory Course	8	Practice of Teaching	4		
Schiller	7	History of Education	6		
	—15	School Supervision	2		
One unit in excess of requirement.			—12		
Latin:					
Livy	3				
Cicero and Terence	3				
Horace	3				
Pliny	3				
	—12				
Greek:					
Twelve books of Homer	3				
Tragedy and Lyric Poetry	3				
	— 6				
Total Prescribed Studies	62	Total Free Electives	43	Total Group Electives	30
Total requirement for graduation	60	Total requirement for graduation	35		
In excess of requirement	2	In excess of requirement	8		

Miss C.

College of Social Sciences; Graduate of the Year 1896; Degree of B.L.

Credits for Entrance Requirements from the Oakland High School: Elementary English, Algebra through quadratics, Plane Geometry, Geography and U. S. History, Cæsar's Gallic War, Cicero's Orations against Catiline, Elementary Latin Composition, Virgil's Æneid, Cicero's Oration pro Archia Poeta and pro Lege Manilia, Latin at Sight, Advanced Latin Composition, Greek History, Roman History, Mediæval and Modern History, Advanced English, Solid Geometry. (The last subject in excess of the requirements.)

Prescribed Studies.		Free Electives.		Group Electives.	
English:	Units.	*Philosophy:*	Units.	*Latin:*	Units.
Prose Style	8	Logic	4	Tacitus' Annals	2
Themes	2	Psychology	4	Latin Composition	2
	—10		— 8	Lucien's Pharsalia	1
Mathematics:		*Pedagogy:*		Patristic Latin	3
Algebra	3	History of Education	6	Tacitus' Histories	2
Conic Sections	3	School Systems	2	Early Latin	3
Trigonometry	3		— 8		—13
Logic of Mathematics	2	*English:*		*English:*	
	—11	History of English Literature	6	Exposition	2
One unit in excess of requirement.				Poetics	2
		French:		Old English	5
Natural Sciences:		Lectures on French Literature	4	Adv. Old English	4
Zoölogy	4	Victor Hugo's Prose	4	Shakespeare	2
Geology	6		— 8	Literary Criticism	3
Botany	3	*History:*		Tennyson and Browning	2
	—13	European	4		—20
One hour in excess of requirement.					
French:		*Chemistry:*			
Introductory Course	8	Elementary	4		
Le Roi des Montagnes	6				
	—14				
Latin:					
Livy	6				
Latin Composition	2				
Horace, Cicero, Pliny	6				
	—14				
Total Prescribed Studies	62	Total Free Electives	38	Total Group Electives	33
Total requirement for graduation	60	Total requirement for graduation	35	Total requirement for graduation	30
In excess of requirement	2	In excess of requirement	3	In excess of requirement	3

Mr. D.

College of Natural Sciences; Graduate of the year 1896; Degree of B.S.

Credits for Entrance Requirements on Certificate from the Oakland High School: Elementary English, Algebra through quadratics, Plane Geometry, Government of the United States, Cæsar's Gallic War, Cicero's Orations against Catiline, Elementary Latin Composition, Greek History, Roman History, Physics with Laboratory, Chemistry with Laboratory, Mediæval and Modern History, Advanced English, German Grammar, Translation and Prose Composition. (Chemistry in excess of requirements, and German in lieu of Advanced Latin.)

Prescribed Studies.		Free Electives.		Group Electives.	
English:	Units.	*English:*	Units.	*Zoölogy:*	Units.
Prose Style	4	History of the Drama	2	Comparative Zoölogy	4
Practical Rhetoric	4	Germanic Sources of English Life and Culture	1	Morphology of Invertebrates	3
Summaries	1		— 3	Morphology of the Lower Vertebrates	3
Themes	4	*German:*		Microscopical Anatomy	5
	—13	Scientific German	6	Embryology	5
Three units in excess of requirement.		*Chemistry:*		Bacteriology	4
Mathematics:		Elementary Chemistry	4		— 24
Algebra	3	Analysis of Iron, Steel, and Alloys	2	*Botany:*	
Trigonometry	3	Physiological Chemistry with Laboratory	3	Morphology of the Compositæ	6
Analytic Geometry	3	Urine Analysis	2		
Solid Geometry	2		—11		
	—11	*Botany:*			
One unit in excess of requirement.		Vegetal Structure and Morphology	3		
Natural Sciences:		Systematic and Economic Botany	3		
Physics	8		— 6		
Chemistry	19				
	—27				
One unit in excess of requirement.					
French:					
Introductory Course	8				
Corneille, Racine	3				
Two dramas of Victor Hugo	3				
	—14				
Military Science and Tactics	5				
Total Prescribed Studies	70	Total Free Electives	26	Total Group Electives	30
Total requirement for graduation	65	Excess from Prescribed Studies	5		
In excess of requirement	5		31		

These four schedules have been selected as typical cases, and from them a first judgment may possibly be formed concerning the efficiency of the new grouping for its purpose, as expressed in the University Register in the following language: "This reorganization of the curriculum secures a division into general or fundamental courses on the one hand, and special or advanced courses on the other. With his entrance upon the Elective Group the student is introduced to aims and methods of study which obtain not only for higher undergraduate courses, but for graduate work. The reorganization secures, also, the regulation of the purely elective element by the restriction of at least one half of it to a group chosen in a special department of scholarship. It is believed that this adjustment of courses is preferable both to the system of rigid prescription and to that of unrestricted freedom in election, since it provides not only for liberal culture, but for concentrated and systematic study in the direction of the student's preference, and for training in methods of original investigation."

In how far is this measure filled up by good work executed in accordance with the sample schedules here presented?

The Philosophical Union has continued to hold its regular monthly meetings, supplemented by adjourned sessions and special meetings. In 1893–94 the programme of eight sessions was devoted to a discussion of Fiske's Idea of God, and of the bearing on personality, Divine and human, of its evolutional view of God as imminent in the world. These meetings excited great interest, and their topic was continued through the succeeding year 1894–95, by a discussion of the nature of God and the proofs of his existence, guided by a study of the work entitled The Religious Aspect of Philosophy, by Professor Josiah Royce, of Harvard University, a graduate of our University in the class of '75. The year was signalized by a visit of Professor Royce to the Union, in August, 1895, and his delivery before it of a public address on the Conception of God; the address was followed by critical papers, presented by Professor Sidney Mezes, of the University of Texas, a graduate of our Department of Philosophy, and later a pupil of Professor Royce; by Professor Joseph Le Conte; and by Professor Howison. The address and criticisms were published; and, besides two hundred copies distributed among the members, about six hundred were sold in various parts of the country, most of them in California. At the time of this visit, Professor Royce also addressed the Union at three special meetings, developing his views on Will as applied to an Absolute Being, and on the psychology of the individual with reference to the consciousness of self. The year 1895–96 was occupied with studies of the work by Professor John Watson, of Queen's University, Kingston, Canada, on Comte, Mill, and Spencer, and the involved critique of agnosticism. At the thirteen meetings given to this subject, papers were presented by

Professors Le Conte, Stringham, Slate, Gayley, Jones, and Howison; by Professor Griggs, of Stanford University; by Associate Professor Haskell and Assistant Professor Ritter; by Instructor McGilvary, and by Dr. Hinman, Fellow in Philosophy; and by Emmet Rixford, M.D., S. M. Augustine, Esq., and Mr. F. C. Torrey. Professor Watson himself closed the series, in May, 1896, with a course of four lectures before the Union, and by a public address on the Greek and Christian Ideals of Life. The address and two of the lectures have now been published in a volume entitled "The Christian Ideal of Life, in Its Relation to the Hebrew and Greek Ideals, and to Modern Idealism." It is hoped that these visits to the Union by its eminent corresponding members will be continued each year.

The *Longfellow Memorial Association* has just closed its thirteenth year of literary and social work. During the year 1895–96, under the presidency of Professor L. DuPont Syle, of the English Department, the following papers were presented and discussed: A Day in Florence, by Miss E. B. Packard, of the Oakland High School; Socialism, by Professor L. T. Hengstler; Heredity, by President David Starr Jordan, of Stanford University; Spain and The Spaniards To-Day, by Professor Bernard Moses; The Life and Art of Defoe, The English Comedy of Manners, The Life and Work of Swift, The Defects of Congressional Government, by Professor L. DuPont Syle.

The *Science Association of the University of California* holds general meetings about once a month, open to the public, and frequent sectional meetings under the chairmanship of the Vice-Presidents of the various sections. At present there are five sections: 1. Mathematics and Astronomy; 2. Chemistry; 3. Geology and Mineralogy; 4. Botany; 5. Zoölogy. The following topics have been presented at the general or special meetings of the association during the academic years 1894–95 and 1895–96, in the form of papers or lectures:

1894–95.

October 9—Forces which have Determined the Forms of Modern States; by Professor Bernard Moses.

October 13—The Work and Methods of the Geological Survey; by C. D. Walcott, Director of the U. S. Geological Survey.

November 7—Egyptian Art, illustrated; by Associate Professor Hy. T. Ardley.

December 4—The Basis of Scientific Philosophy; by Assistant Professor C. W. Woodworth.

January 25—The Nicaraguan Canal; by Captain W. L. Merry, Nicaraguan Consul-General at San Francisco.

February 5—What is Good Architecture; by Mr. Bernard R. Maybeck.

March 5—The Ultimate Effect of a Heat-trapping Atmosphere upon the Climate of a Planet; by Dr. Marsden Manson, of San Francisco.

April 2—Some Thoughts on the Primary Divisions of the Geological Record; by Professor Joseph Le Conte.

May 7—The Importance of the Beet-Sugar Industry for California; by Dr. Julius Koebig, of San Francisco.

1895–96.

September 20—Color Perception and Color Blindness; by Professor Joseph Le Conte.

October 4—Recent Progress in Astronomical Photography; by Professor E. E. Barnard, of the University of Chicago.

October 25—Auguste Comte, and his Influence on Modern Thought; by Professor Lester F. Ward, of the Smithsonian Institution.

November 8—Physical Features of the Hawaiian Islands; by Dr. A. B. Lyons.

December 13—Glimpses of Guatemala and Mexico, the Present and the Past; by Dr. Gustav Eisen, of the California Academy of Sciences.

February 3—Human Foods and Practical Dietetics; by Mr. M. E. Jaffa.

March 5—The Line of Investigation which has resulted in Professor Roentgen's Discovery; by Professor F. Slate.

April 3—Electric Waves, illustrated by experiments; by Mr. W. J. Raymond.

April 24—Ancient and Modern Guatemala, illustrated by stereopticon projections; by Dr. Gustav Eisen, of the California Academy of Sciences.

Farmers' Institute meetings, conducted by the College of Agriculture as a phase of University extension, are growing in public favor, and applications for the meetings exceed the ability to supply them. During the first three years after the work was begun in 1891 there were 35 institutes held, usually two days to each institute, with attendance ranging from 50 to 300 at the sessions. During the last two years 20 meetings have been held. At nearly all of them there have been two University representatives present, who have delivered stated lectures upon subjects of local importance, and the localities have furnished groups of excellent speakers upon pertinent agricultural and educational topics. In addition to the regular Farmers' Institute work, the staff of the College of Agriculture has done much in the same line, though under a different name. At Camp Roache, a summer school of agriculture in the Santa Cruz Mountains, under the auspices of the State Grange, four lecturers from the State University participated. At conventions and local meetings of fruit-growers, viticulturists, and dairymen, chiefly in the central region of the State, the staff has taken an active part, and demonstrations of College and Experiment Station work in various lines have been made.

The following lectures have been delivered by officers of the United States Army before the classes in Military Science:

January 23, 1895—The Red Cross Society, and the Care of the Wounded in Battle; by Lieut.-Col. C. R. Greenleaf, of the Medical Department, U. S. Army.

February 5, 1895—The Importance of Military Training in the United States (before entire Corps); by Lieut.-Col. J. S. Lee, of the Quartermaster's Department, U. S. Army.

March 13, 1895—Artillery; by Capt. Henry J. Reilly, Fifth Artillery, U. S. Army.

November 20, 1895—Care of the Wounded in Battle; by Lieut.-Col. C. R. Greenleaf, of the Medical Department, U. S. Army.

March 25, 1896—Artillery; by Capt. Henry J. Reilly, Fifth Artillery, U. S. Army.

April 1, 1896—Cavalry; by Capt. Alexander Rodgers, Fourth Cavalry, U. S. Army.

April 15, 1896—Seacoast Defenses; by First Lieut. Joseph E. Kuhn, of the U. S. Corps of Engineers.

Reference should be made to the experimental and observational work in Primary and Grammar School organization, supervision, and methods, that has been in progress during the past two years at the Tompkins School in Oakland, under the supervision of the Department of Pedagogy. The University owes this opportunity to the Oakland City Board of Education. Several years must elapse before definite results can be reached, but a corps of earnest teachers under the guidance of Professors Brown and Bailey are accumulating good material, out of which something of real value to education may be expected to come.

Especially worthy of note was the very creditable presentation by students on the stage, under the direction of Professor L. DuPont Syle, near the close of the last term, of Congreve's "Love for Love." Extensive modifications of the play, necessary to its proper presentation before a nineteenth century audience, were very successfully carried out by Professor Syle, and an appropriate prologue was written for it by Professor Flagg. Accounts of the preparation and the performance of the play are given in the *University of California Magazine* for May, 1896.

The *Students' Aid Society* is an organization whose object it is to assist needy and deserving students, not by gratuity of any sort, but by securing for them opportunities to help themselves. During the college years 1894–96 it has assisted nearly one hundred young men and young women to secure employment, the returns for which have aggregated $3,874 60.

The *Students' Coöperative Society* exercises the important function of supplying our classes with text-books, and the volume of its transactions has increased *pari passu*, with our increase in numbers. The statistics of sales for the past five years are as follows:

	1891–92.	1892–93.	1893–94.	1894–95.	1895–96.
Sales	$9,523 04	$12,970 93	$14,500 00	$20,000 00	$23,000 00
Number of students at Berkeley	547	650	815	1,124	1,336

The business affairs of the Association are well managed, and its financial standing is so good that it is able to command special rates from publishers.

The *University Dining Association*, organized three years ago for the purpose of providing a suitable lunching-place for students, has struggled against financial difficulty from the beginning. It has been several times saved from failure by the generosity of a few members of the Academic Council, who regard it as an important item in our University equipment.

Respectfully submitted.

IRVING STRINGHAM,
Dean.

REPORT OF THE SAN FRANCISCO ART ASSOCIATION.

(MARK HOPKINS INSTITUTE OF ART.)

San Francisco, August 20, 1896.

To the President of the University:

Dear Sir: Since my last biennial report the School of Design has established an evening class in Architectural Drawing, under the supervision of Mr. Bernard R. Maybeck, which is composed of about twenty students from offices of local architects; also, evening classes in Drawing from Life and the Antique have just been opened under the supervision of Professor John A. Stanton, and already have an attendance of forty students, largely composed of teachers in the public schools and young men from lithographic, architectural, and engineering establishments, wishing to perfect themselves in freehand drawing.

The regular day classes of the school have continued to slowly increase in number, and a marked improvement in the quality of the work performed by the students has been verified by the studies exhibited in the two annual exhibitions held since my last biennial report.

In addition to the three annual gold medals heretofore given by the school, Mr. James D. Phelan has established a medal for Modeling from Life, to be known as the Phelan Medal.

It has been decided to award a Certificate of Proficiency to such students as may pass the prescribed examinations, commencing with the present school year to the close, May 15, 1897.

Mr. Edward F. Searles's interest in the institution and school is unabated, and he has lately presented the institute with a number of valuable paintings and many choice additions to the library.

Donations of paintings have also been received from Mrs. Phebe A. Hearst; a collection of studies in oil of early California artists, from Mrs. Benjamin P. Avery; a portrait of himself, from Mr. Irving M. Scott; and gifts of photographs, sketches, studies, etc., from Mr. William Alvord, Mr. George H. Sanders, Mr. Charles R. Bishop, Mr. Rupert Schmidt, Mrs. Emma Shafter Howard, the late Mrs. M. B. M. Toland, Mr. Edward Bosqui, Mr. Alexander Oakey, and Mr. James D. Phelan; also, donations to the library from Mr. William Alvord, Mr. James D. Phelan, Mr. Henry Heyman, Mr. H. H. Moore, Mr. Samuel P. Avery, Mrs. F. F. Low, Mr. L. H. Brown, The Channing Auxiliary, and others.

At the suggestion of Mr. Edward F. Searles, the association appointed the first Friday of each month as a free day, and opened the house and exhibition free to the public on Friday, April 9th. Twenty-six hundred persons availed themselves of this opportunity to visit the institution. The following free day the attendance increased to four thousand visitors, and has been about three thousand each succeeding free day.

Mr. James D. Phelan presented the association with $1,000, to be awarded for the following purpose: $800 to be paid for the best picture painted by a California artist, resident in the State, representing one of these subjects: "The Discovery of the Pacific Ocean," by Balboa; "The Discovery of California," by Cabrillo; "The Discovery of the Bay of San Francisco," by Portola; "The Entrance of the First Vessel through the Golden Gate." The second choice in the competition shall receive $150, and the third $50. The picture receiving the first prize shall belong to the association, and all the competitive canvases shall be exhibited at the spring exhibition of the association, held April, 1896, at which time the selections shall be made by the judges.

The judges awarded the first prize to Mr. Arthur F. Mathews, the second prize to Mr. William Keith, and the third prize to Mr. Emile M. Pissis. It is to be hoped that other public-spirited citizens will follow the generous example of Mr. Phelan, and by that means assist the association in increasing and elevating the standard of art on the Golden Shore.

Respectfully submitted.

J. R. MARTIN,
Assistant Secretary.

REPORT OF THE DEAN OF THE MEDICAL DEPARTMENT.

San Francisco, August 19, 1896.

To the President of the University:

Dear Sir: I have the honor to submit to you the following report of the progress and needs of the Medical Department of the University.

In order to conform to the custom of Eastern Medical Colleges and of the academic branches of the University, the Faculty determined to abandon the plan, until recently followed, of having spring and summer sessions. The course now begins September 1st, and continues eight calendar months.

The Medical Department of the University has suffered from a weakness common to almost all American medical institutions in the insufficiency of the preliminary education of the matriculants. With the beginning of the last session applicants for admission were required to present satisfactory credentials, or pass examinations equal to those given at the close of the second year in good High Schools. After the coming session the preliminary requirements of this department will be the same as for entrance to the Colleges at Berkeley. Applicants for admission will be required to present their credentials to the regular examining board of the academic departments of the University, and, if such credentials are not satisfactory, to pass the regular examinations conducted at Berkeley.

Since my last report the course has been lengthened to four years. Graduates of recognized literary and scientific colleges, and those who spent two years in the Natural Science Course of a recognized university, are admitted to the second-year class without examination. It is to be hoped that there will soon be inaugurated a plan whereby a student taking three courses of specially prescribed studies at Berkeley and three at this department may, at the end of his six years of study, receive the two degrees of Bachelor of Science and Doctor of Medicine.

The improvements made by the Faculty have been accomplished in the face of serious disadvantages. The building now occupied, the gift of the late Dr. H. H. Toland, has become unfit for the teaching of medicine in its modern form. The Faculty feels that a new era of prosperity will begin with the completion of the building for which the Legislature, at its last session, generously appropriated $250,000 for the professional departments of the University. It can hardly be doubted that the establishment of such an institution will exert an influence upon the *esprit de corps* of the whole University that cannot be overestimated.

The Faculty earnestly hopes that the Board of Regents will appreciate the efforts to raise the standard of medical education, and devise some means by which the Faculty may be given some source of revenue with which to meet the expenses of the institution besides the fees paid by students.

Respectfully submitted.

R. A. McLEAN,
Dean of Medical Faculty.

REPORT OF THE SECRETARY OF THE POST-GRADUATE MEDICAL DEPARTMENT.

(SAN FRANCISCO POLYCLINIC.)

San Francisco, August 21, 1896.

To the President of the University:

Dear Sir: The San Francisco Polyclinic, as the Post-Graduate Medical Department of the University of California, has been, during the present year, more successful in attracting students than in the past. While, in 1895, only six graduates in medicine availed themselves of the opportunities for study, supplied by the abundant material of this institution, fifteen students have been enrolled between the first of January and the first of August, 1896. Most of these come from remote places, the majority from the State of Oregon; California furnished only four, all of them residents of San Francisco.

It was decided in the beginning of the year to arrange special courses, the subjects, time, and terms of which were to be announced beforehand, in the hope of forming classes and systematizing and concentrating the instruction more than previously, by attracting simultaneously a number of those interested in the same branches. Accordingly, last January, two thousand circulars were issued and distributed among the physicians on this coast, informing them of the intention to give a course on Gynecology. Although this effort was not unsuccessful, yet it was recognized that there were not sufficient applicants to encourage us in adopting this as the sole method of announcing and prosecuting our didactic work; and we have continued the system of individual instruction whenever required, with the intention of offering courses for classes from time to time.

The Trustees of the Polyclinic persevere in their endeavors to complete the equipment of the Bacteriological Laboratory. They have secured in Dr. Charlotte B. Spring an eminently capable Demonstrator of Bacteriology, whose meritorious work has already been appreciated by local practitioners and students from other States.

Respectfully submitted.

LEO NEWMARK,
Secretary Board of Trustees San Francisco Polyclinic.

REPORT OF THE DEAN OF THE COLLEGE OF DENTISTRY.

San Francisco, August 19, 1896.

To the President of the University:

Dear Sir: I have the honor of making the following report of the condition of the College of Dentistry of the University of California. Since the last biennial report the College has reached the maximum of attendance, being nearly double that previously reported.

The advanced standard of entrance requirements seems to be no barrier, but on the contrary, brings us better material, a large percentage of those applying last term being graduates of accredited schools.

The curriculum of the school is a graded one, covering three years of nine months.

We have strengthened the curriculum each year, particularly in the Manual Training Department.

Technic teaching is now the essential feature of a Dental College course. Many original methods have been developed in our own department.

We have in every way outgrown the accommodations afforded us in the building now occupied, and anticipate with pleasure the promised completion of our new building on the "Sutro site."

With increased facilities and better accommodations, we can easily take and maintain first rank.

Out of the thirty-eight schools forming the National Association of Dental Faculties, the College of Dentistry of the University of California ranks second in point of entrance requirements and curriculum. There are but three other schools in the country that have the same length of term; the remainder of the schools forming the association have terms of six months only.

We have every reason to be satisfied with results, as our graduates take rank with the best wherever they go.

Respectfully submitted.

LUIS LANE DUNBAR,
Dean.

REPORT OF THE DEAN OF THE COLLEGE OF PHARMACY.

San Francisco, August 18, 1896.

To the President of the University:

Dear Sir: The condition of the Department of Pharmacy during the year 1895 did not differ materially from that of the previous year, as shown in the last report. The total number of students was 114. Of these, 39 were in the Senior Class and 75 in the Junior. The result of the final examinations (at the close of the term) shows that the difference in the number in the Senior and Junior Classes remains about the same. This is due to the fact that some who enter never complete the work of the Junior course, either from having lost the student habit, or from discouragement at the poor prospects of pharmacy in a financial way in the event of success, or from other causes. Of the 75 Senior students, 26 were graduated (receiving the degree of Graduate in Pharmacy).

It is gratifying to find that the raising of the entrance requirements did not greatly reduce the number seeking admission to this department. It is probable that the more stringent final examinations, that reduce the number of Seniors recommended for graduation, and of Juniors promoted to the Senior class, have somewhat affected the attendance at the session of 1896. But the Faculty and Trustees believe that in another year or two persons contemplating the study of Pharmacy will take these things into consideration, and adjust themselves to the advanced standards now set.

Respectfully submitted.

W. M. SEARBY,
Dean.

PUBLISHED WRITINGS OF MEMBERS OF THE FACULTY.

R. G. AITKEN, A.M.,

Assistant Astronomer (L.O.).

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HENRY T. ARDLEY, S.A.,

Associate Professor of Decorative and Industrial Art.

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KENDRIC CHARLES BABCOCK, Ph.D.,

Instructor in History.

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THOS. P. BAILEY, Jr., Ph.D.,

Assistant Professor of Pedagogy.

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R. E. BARNARD, A.M., Sc.D.,

Astronomer (L. O.).

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H. H. BEHR, M.D.,

Emeritus Professor of Botany (Ph.).

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W. C. BLASDALE, B.S.,

Instructor in Chemistry.

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W. B. BOSLEY, A.B., LL.B.,

Assistant Professor of Law.

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C. B. BRADLEY, A.M.,

Professor of Rhetoric.

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ELMER E. BROWN, Ph.D.,

Professor of the Science and Art of Teaching.

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W. W. CAMPBELL, B.S.,

Astronomer (L. O.).

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E. B. CLAPP, PH.D.,

Professor of the Greek Language and Literature.

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GEO. E. COLBY, PH.B.,

Instructor in the Viticultural Laboratory.

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A. L. COLTON, A.B.,

Assistant Astronomer (L.O.).

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J. BURTT DAVY,

Assistant in the Botanic Garden.

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C. M. GAYLEY, A.B

Professor of the English Language and Literature.

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C. L. GODDARD, A.M., D.D.S.,

Professor of Orthodontia (D).

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M. W. HASKELL, Ph.D.,

Associate Professor of Mathematics.

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E. W. HILGARD, Ph.D., LL.D.,

Professor of Agriculture and Agricultural Chemistry, and Director of the Agricultural Experiment Stations.

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FINANCIAL STATEMENT.

NOTE.—The Act of the Legislature of the State of California, entitled "An Act to provide for the permanent support and improvement of the University of California by the levy of a rate of taxation and the creation of a fund therefor," approved February 14, 1887, contains the following provision:

Section 5. The money derived from said fund must be applied only to the support and permanent improvement of the University, and the Board of Regents must include in its biennial report to the Governor a statement of the manner and for what purposes the money was expended.

The following statement shows in outline the manner and purposes of the expenditures of the State University Fund for the fiscal years 1894–95 and 1895–96. Statements showing these expenditures in detail are given in the Annual Report of the Secretary of the Board of Regents for the years mentioned, copies of which are sent herewith:

	1894–95.	1895–96.
RECEIPTS.		
Cash on Controller's warrants	$119,824 73	$112.543 56
EXPENDITURES.		
To Department of Lick Observatory	$20,980 26	$20,408 91
To Department of Mineralogy	496 99	692 94
To Department of Botany	543 30	388 07
To Department of Biology	459 85	
To Department of Physics	940 03	967 33
To Department of Physical Culture	249 62	3,693 05
To Department of Military Science	305 37	
To Department of Latin	49 71	
To Department of Natural Science	12,767 79	5,400 00
To College of Chemistry	17,616 94	
To College of Civil Engineering	4,978 71	
To Museum	2,998 85	1,290 61
To Library	3,550 88	5,578 34
To University Site Improvements	4,287 69	5,071 04
To University Printing Office	2,054 89	2,159 43
To fuel	1,527 56	1,456 39
To equipment	2,082 63	1,714 64
To repairs	2,438 43	1,373 02
To advertising and printing	197 40	134 45
To telegraphing and expressage	605 72	594 70
To printing monographs	206 05	
To stationery	241 73	259 25
To college celebrations	366 00	318 50
To postage	497 00	603 00
To official and lecturing expenses	4,326 05	1,616 70
To water	3,226 09	6,672 37
To permanent improvements	31,829 19	
To College of Letters		25,687 72
To College of Social Sciences		23,908 81
To Propagating House		2,355 04
To insurance		162 25
To publications		37 00
Totals	$119,824 73	$112,543 56

ANNUAL REPORT

OF THE

Secretary to the Board of Regents

OF THE

UNIVERSITY OF CALIFORNIA,

FOR THE YEAR ENDING JUNE 30, 1896.

SACRAMENTO:
A. J. JOHNSTON, : : : : : SUPERINTENDENT STATE PRINTING.
1896.

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ANNUAL REPORT OF THE SECRETARY

TO THE

BOARD OF REGENTS OF THE UNIVERSITY OF CALIFORNIA.

To the Honorable the Regents of the University of California:

GENTLEMEN: I have the honor to submit my report for the year ending June 30, 1896.

I. BOARD OF REGENTS.

EX OFFICIO REGENTS.

HIS EXCELLENCY JAMES H. BUDD..........Sacramento,
Governor, ex officio President of the Board.

HIS HONOR WILLIAM T. JETER..........Santa Cruz,
Lieutenant-Governor.

HON. JOHN C. LYNCH..........Cucamonga,
Speaker of the Assembly.

HON. SAMUEL T. BLACK..........Sacramento,
State Superintendent of Public Instruction.

C. M. CHASE..........11 Montgomery Street, San Francisco,
President of the State Agricultural Society.

ERNST A. DENICKE..........320 Sansome Street, San Francisco,
President of the Mechanics' Institute.

MARTIN KELLOGG..........Berkeley,
President of the University.

APPOINTED REGENTS.

	Term Expires.
George Thomas Marye, Jr., 234 Montgomery Street, San Francisco	1898
J. West Martin, Union Savings Bank, Oakland	1898
John E. Budd, Stockton	1900
Henry S. Foote, U. S. Appraisers' Building, San Francisco	1900
Isaias William Hellman, Nevada Bank, San Francisco	1902
William T. Wallace, 799 Van Ness Avenue, San Francisco	1902
Charles Frederick Crocker, Union Trust Company Building, San Francisco	1904
James Franklin Houghton, 223 Mission Street, San Francisco	1904
Arthur Rodgers, 309 Montgomery Street, San Francisco	1906
Albert Miller, San Francisco Savings Union, San Francisco	1906
James A. Waymire, Alameda	1908
Andrew S. Hallidie, 8 Pine Street, San Francisco	1908
Charles W. Slack, New City Hall, San Francisco	1910
Chester Rowell, Fresno	1910
Timothy Guy Phelps, San Carlos	1912
J. B. Reinstein, 217 Sansome Street, San Francisco	1912

Terms of Regents expire March 1st.

OFFICERS OF THE BOARD OF REGENTS.

James H. Budd, Governor of the State ....Sacramento,
Ex officio President of the Board.

J. H. C. Bonté......................No. 2610 Dwight Way, near Choate Street, Berkeley,
Secretary and Land Agent.

William Alfred McKowen ....Fernwald Avenue, Berkeley,
Assistant Secretary.

William Henry Phipps ....2610 Bancroft Way, Berkeley,
Clerk in Secretary's Office.

Louis Sloss ....310 Sansome Street, San Francisco,
Treasurer.

John Bell Mhoon....................................401 California Street, San Francisco,
Counsel.

Regular meetings of the Board of Regents are held at the Mark Hopkins Institute of Art, in San Francisco, on the second Tuesday of each month, and in Berkeley annually, the day before Commencement Day.

The number of meetings of the Board during the year ending June 30, 1896, was 24. Number of Regents attending, 322; average attendance, 13.

STANDING COMMITTEES.

(Nominated by the Board and confirmed by the Governor.)

The following have been nominated and confirmed as the standing committees for the year ending June 30, 1897:

Finance and Audit—Regents Hallidie, Miller, and Hellman.

Internal Administration—Regents Marye, Slack, and Black.

Law—Regents Wallace, Rodgers, and Foote.

Grounds and Buildings—Regents Martin, Reinstein, and J. E. Budd.

Library and Museum—Regents Black, Reinstein, and Crocker.

Lick Observatory—Regents Phelps, Crocker, and Slack.

Congressional Land Grant—Regents Houghton, Rodgers, and Denicke.

United States Agricultural Experiment Stations—Regents Chase, Phelps, and Martin.

SPECIAL COMMITTEES.

(Appointed by the Board.)

To Confer with Ways and Means Committee of the Joint Committee on Site for Building for the Affiliated Colleges of the University—Regents Crocker, Houghton, and Miller. [July 23, 1895.]

On Nomination of Committees of the Board for the Year 1895–96—Regents Bartlett, Martin, and Slack. [July 23, 1895.]

To Meet the Several Committees Interested in the Establishment of the Wilmerding School of Industrial Art—Regents Miller, Bartlett, and Marye. September 10, 1895, Regents Martin and Hallidie were added to this committee.

To Prepare Memorial of the Late Regent Ainsworth—Regents Rodgers, Kellogg, and Bartlett. [November 12, 1895.]

To Carry Out Plans for Lighting Library and Grounds—Regent Reinstein, President Kellogg, and Professor Cory. [January 14, 1896.]

On Congressional Bill to Equalize Land Grants to the Several Universities—Regents Kellogg, Houghton, and Marye. [March 10, 1896.]

On Ways and Means—Regents Reinstein, Rodgers, and Black. [May 12, 1896.]

To Nominate Members of the Various Standing Committees for the Fiscal Year 1896–97—The President of the Board, the President of the University, and Regent Phelps. [May 12, 1896.]

Regent Phelps moved that the President of the Board be an ex officio member of all committees. [Carried May 13, 1896.]

On motion, Regent Slack was appointed on the Committee on Internal Administration, vice Regent Bartlett, term expired. [March 31, 1896.]

On motion, Regent Reinstein was appointed on the Committee on Library and Museum, vice Regent Bartlett, term expired. [March 31, 1896.]

On motion, Regents Slack and Reinstein were added to the Law Committee, temporarily. [April 7, 1896.]

Regent Hallidie, Chairman of the Finance Committee, submitted the following:

In the absence of Regent Hellman, there are only two members of the Finance Committee. We recommend that Regent Denicke be added to that committee until Regent Hellman's return. [Approved June 23, 1896.]

II. MEMORIAL OF REGENT GEORGE J. AINSWORTH.

Regent Rodgers submitted the following:

The death of our youngest member, George Jennings Ainsworth, occurred on the 20th day of October, 1895. It is meet that we pause to contemplate for awhile the simple and noble life just passed among us; his career as a student and graduate of the University, and his simple, dignified, intelligent, and modest performance of his duties as a member of this Board; his courteous, manly, and coöperative bearing toward his associates; his enthusiastic and sustained interest in the University, in its students, its Faculty, its graduates, and his appreciation of its high mission in the future, endear him to every lover of the University. His manly performance of the duties devolving upon him, as well as his manner, character, and bearing toward us, will ever be an inspiring recollection to all of us. We cannot refrain from mention of his unofficial virtues, at least to the extent to express our profound sympathy for his widow and children, in their irreparable loss of a loving husband and father.

[Received and ordered spread on the minutes, and a copy sent to Mrs. Ainsworth, January 14, 1896.]

III. MEMORIAL OF EX-REGENT ANDREW J. MOULDER.

Regent Martin submitted the following:

Mr. President, and Gentlemen of the Board of Regents:

I ask the privilege of a few brief words, as a tribute to the memory of one who was not only a distinguished member of the Board of Regents in the earlier history of the University, but was likewise its honored, trusted, confidential Secretary for many years.

Mr. President, we have received with the deepest sensibility and most profound regret information of the recent death of the Hon. Andrew J. Moulder, who surrendered his life almost in the midst of the daily performance of his public duties and while still clothed with the insignia of official station. As a member of the Regency he was prominent, intelligent, and worthy—graceful and forcible in the expression of his views, and profound in his conclusions—with a thorough knowledge of University affairs, with great executive ability, he wielded commanding influence—he was a man of great personal attractions and rare literary and scientific attainments—of unblemished honor and incorruptible integrity—his life presented a most happy blending of high-bred courtesy and manly courage and independence. He enjoyed the undivided confidence of his brother Regents and exercised great influence in their counsels and deliberations.

Mr. Moulder resigned from the Board of Regents in order to become Secretary of the University, a position to which he had been previously elected, and in that capacity he proved himself a model executive officer, an example to all that came after him.

He organized the system upon which our financial resources were administered, and formulated the rules and forms which have governed this Board from its foundation, many of which have been perpetuated to the present time, intended for the safe and proper government of the University.

So prominent as Regent, so influential as Secretary, with great practical ability, made him a prominent factor in the establishment and founding of the University.

From early manhood in his native State of Virginia to the close of the long, useful, and eventful life in California, he had devoted most of the intervening years to the cause of popular education—it seemed to be his chosen life-work.

From Regent of the University, Secretary of the University, State Superintendent of Public Instruction, Municipal Superintendent of the Public Schools of San Francisco, illustrates the esteem and confidence in which he was held, and his great popularity with the people of the State.

One so intimately associated with the University in its earlier years, and holding such exalted stations of trust, is preëminently worthy of an imperishable record, where his name and his fame as an honorable educator and examplar should be accessible to the coming generations for a life worthy of highest imitation, and distinguished for the special qualities of morality, integrity, and fidelity.

Mr. President, eulogy at this hour, sir, will not augment nor exalt the sphere of his usefulness, nor more firmly establish the well-earned reputation that crowns his noble life. The loss of such a man is public calamity, a bereavement that strikes and rends the tenderest cords of the human heart and ruthlessly severs the sacred ties of love and affection, and cruelly obliterates every cherished memory, every earthly attachment.

Mr. President, the name of this distinguished man and faithful public servant should not be forgotten, nor the luster of his honorable career be obscured or lost to memory.

I move, sir, that these remarks, when properly formulated, be spread upon the records of the University, as a perpetual memorial to the honor of Andrew Jackson Moulder.

[Ordered spread upon the minutes and a copy sent to Mrs. Moulder, December 10, 1895.]

IV. TRANSACTIONS OF THE BOARD.

1. Department of Agriculture.

Section 5 of Report of Special Committee on Morrill Fund Rescinded.—Regent Hallidie, Chairman of the Finance Committee, submitted the following:

At the meeting of the Board, held March 10, 1891 (Minutes, Vol. 8, p. 231), the report of the Special Committee on Morrill College Aid Fund was adopted. Section 5 of said report is as follows:

> That all persons or officers hereinbefore mentioned shall act in the double capacity of lecturers or instructors, and of officers of the Agricultural Experiment Station, in such manner as may be expedient, and determined by the Professor of Agriculture and Director of the Station, in concert with the President, or, in his absence, the Chairman of the Faculties. They may be called upon to participate in the Farmers' Institutes, and their expenses incurred while doing so, as well as those of other lecturers that may be called in, shall be paid out of the fund already referred to, under the same rules as now govern the traveling expenses of the Director, Inspector of Stations, and other officers of the Experiment Station. For the payment of such expenses, a sum not exceeding $1,000 per annum is hereby set apart from the same funds.

Your committee recommends that the action contained in said section be rescinded. [Concurred in April 14, 1896.]

Attorney of Board to Report if Appropriation of $2,500 to carry on Work of Viticultural Commission is Available.—Regent Houghton, Chairman of the Committee on Agricultural Experiment Stations, submitted the following:

Resolved, That the Attorney of this Board be requested to examine the Act of the last Legislature abolishing the State Viticultural Commission and appropriating $2,500, to be expended under direction of the Board of Regents, to carry on the work of such Commission, and report to the Secretary of this Board if such appropriation is available for such purpose. [Adopted July 9, 1895.]

Revised Budget for Viticultural Appropriation.—Regent Hallidie submitted a revised budget for the viticultural appropriation for the year

1895–96 (January 1 to July 1, 1896), and recommended that it be approved:

Increase of salaries:		
Hayne	$300 00	
Colby	50 00	
Bioletti	300 00	
		$650 00
Traveling expenses		350 00
Purchase of resistant vines		370 00
Books and periodicals		70 00
Postage		30 00
Labor		250 00
Freight and expressage		130 00
Incidentals		150 00
Apparatus, repairs to laboratory, and field experiments		500 00
Total		$2,500 00

[Approved February 11, 1896.]

Secretary's Report in re Inventory of the Property of the Board of State Viticultural Commission.—The Secretary submitted the following report in relation to the inventory of the property of the Board of State Viticultural Commissioners:

San Francisco, January 14, 1896.

To the Honorable the Board of Regents of the University of California:

Gentlemen: On December 20, 1895, the State Board of Examiners passed the following order:

"It was ordered that J. H. C. Bonté, Secretary of the State University, be and he is hereby authorized to receive for the Regents of the State University, all State property in the hands of the Viticultural Commissioners, giving his receipt for the property received. A copy of the inventory now being made to be forwarded to the State Board of Examiners when it is completed."

Promptly after the receipt of this order, I requested Mr. W. H. Phipps and Mr. F. T. Bioletti to proceed with the work. An inventory of all property that could be found and designated by the officers of the State Viticultural Commission was then taken. I beg leave to submit herewith a copy of this inventory. A list of other property not in possession of the Commission, but belonging to it, was sent to me, and the property will soon be gathered in. All property received by me was receipted for and is now stored in the basement of the University Library building. As I have receipted for this property, I ask your honorable body to designate to whom this property shall be transferred so that I may obtain a proper receipt from those who are to handle and care for it. I respectfully request an order from this Board as to the transfer of the property received.

Respectfully submitted.

J. H. C. BONTÉ,
Secretary.

[On file January 14, 1896.]

INVENTORY OF PROPERTY OF STATE BOARD OF VITICULTURAL COMMISSIONERS.

Main Office.

1 polariscope (Duboscq), 4 cylinders.
1 letter copy book.
1 order book on State Printer.
1 minute book, Ex. Com.
1 minute book, Board.
1 minute book, M. W. Fair.
1 cuspidor.
1 willow basket.
1 aneroid barometer.
1 letter scale.
1 set Becker & Sons' scales.
1 water pitcher.
1 large office clock.
1 waste basket.
1 letter press, stand, and brush, etc.
10 letter copy books.
6 inkstands.
9 rubber stamps and 1 ink pad.
2 letter spindles.
1 microscope case.
1 paper holder and file.
1 city directory.
2 rubber stamps.
6 receipt books.
1 waste basket.
3 red rubber stamps.

Inventory of Property of State Board of Viticultural Commissioners—Main Office—Continued.

1 No. 2 Remington typewriter and cover.
1 box microscopic slides (imperfect mostly).
26 framed pictures.
2 frames containing 37 photos (small).
1 show case, 14 ft. long, in two sections.
1 thermometer.
2 roll-top desks.
2 flat-top desks.
1 typewriter desk.
1 marble-top sideboard.
1 map rack.
9 roller maps.
2 swing office chairs.
7 walnut armchairs.
1 walnut plain chair.
1 roll, 35 maps.
1 umbrella stand.
1 unpublished census of Santa Clara Co.
3 walnut bookcases.
1 bookcase, imitation walnut.
1 map rack.
1 map of San Joaquin County.
1 map of Central California.
1 map of Sonoma County.
1 map of Tulare County.
1 map of San Mateo County.
1 map of Fresno County.
1 map of Monterey County.
1 map of Tehama County.
1 map of San Luis Obispo County.
1 map of Stanislaus County.
1 map of Amador County.
1 map of Kern County.
1 wire reading-stand.
1 relief map of California.
2 French maps.
5 jars sulphur.
6 framed pictures, large.
14 framed pictures, small.
1 6-ft. table.
1 iron safe.
1 chest, 8 drawers.
1 bookrack.
1 redwood bookcase.
1 large office rug, Brussels.
1 hall carpet.
1 walnut armchair.
2 stepladders.
1 broom.
1 carpet-sweeper.
2 feather dusters.
1 walnut table, 3½ ft.
2 oak armchairs.
1 moquet carpet, for large room.
1 carpet lining.
3 oak armchairs.
1 10-ft. walnut table, 8 drawers.
1 redwood set pigeon holes, 24 holes.
1 book, leaves of vines (Natoma Vineyard Co.).
1 paper rack and frame.
19 paper files or holders.
1 8-ft. table.
1 basket.
2 boxes woodcuts and half-tone engravings.
9 cane-seat armchairs.
1 box containing elect. instrument.
1 box containing Maligands ebulliscope.
2 boxes containing Twitchell's acidometers.
1 rotary slide mounting stage.
15 pitted slides (microscopical).
1 slide cabinet.
1 photograph of Palmtag vineyard (framed).
1 letter box.
1 letter scales.
1 bill-holder.
4 wine-glasses.
1 table, 5½ ft.
12 old picture frames.
1 Hoitt tree-grafter.
3 bellows.
1 model filter.
3 glass cylinders.
1 colorimeter.
1 Salleron still.
1 plaster model of a lady.
4 sulphuring cans.
1 Longley mailer.
1 Ciprico model.
2 thermometers.
1 punch.
8 filled letter files.
50 naturalist's collecting vials.
1 combination pigeon-holes and drawers. (18 drawers and 71 pigeon-holes.)
1 bookcase, cherry stain.
1 entomological cabinet with 36 drawers.
4 cuspidors.
1 box containing 9 framed photos of vineyards, made for World's Fair.
1 coal-scuttle.
28 account books.
75 cork slabs.
1 gold pen.
1 large upright walnut desk.
6 pieces brass railing tubes.
1 box woodcuts and zincos.
15 vineyard photos.
1 atlas of Yolo County.
1 package zincos and half-tone cuts.
1 copper still in box.
1 platinum crucible.
1 platinum cup.
1 box picture hooks.
1 annual sizer.
1 electrical and mounting apparatus.
2 large-size black walnut whatnots.
1 bookcase.
1 hektograph (7 parts).
1 quart mucilage.
1 pint carmine ink.
10 wire stands.
11 brass posts.
7 pieces hand rail.
1 large microscope and appurtenances.
1 spectroscope and appurtenances.
1 thermometer.
1 Salleron outfit for acidemetry.
1 Salleron outfit for volumetric analysis.
1 Salleron outfit for alcoholometer.
1 Salleron outfit for gypsum.
1 Fletcher bellows.
1 Weinsauer Messer.
1 alcoholometer.
In Arizona Warehouse:
15 wire frames.

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LIBRARY.

No. of Vols.	Number.	
1	87	Arboriculture, Fruitière, et Viticulture. Baltet.
1	95	Analyse des Vins. Robinet.
1	122	Amelioration des Liquides. Roret.
1	59	Art de Faire le Vin, L'. Ladrey.
1	85	Art de Greffer, L'. Baltet.
2	89–90	Art de Faire le Vin, L'.
1	91	Art de Faire le Vin avec les Raisins secs. Audibert.
1	183	Ampelographie Italienne. Ravaz.
1	187	Analyse des Vins de la Gironde. Faure.
1	411	Avifaune Locali. Giglioli.
1	452	Aufsucht der Seidenraupe. Bolle. Americanischen Reben. Goethe.
1	511	Australian Wine Association, The.
1	515	A Winter in Madeira and a Summer in Spain and Florence. Dix.
1	518	American Grape Vines. Bush & Son & Meissner.
1	555	American Grape-Growing and Wine-Making. Husmann.
1	257	Annali di Agricultura. 1889.
1	258	Annali di Agricultura. 1890.
1	261	Annales de L'Ecole Nationale D'Agriculture de Montpellier.
1	681	Annual Report of State Board of Horticulture. 1883.
1	685	A Treatise on Citrus Culture. 1888.
1	686	Annual Report of State Board of Horticulture. 1889.
1	706	Agriculture of Massachusetts. 1888.
1	707	Agriculture of Massachusetts. 1889.
1	708	Agriculture of Massachusetts. 1890.
1	709½	Annual Report of Mass. State Agricultural College 1865–73.
1	710	Annual Report of Mass. State Agricultural College. 1874–84.
1	711	Annual Report of Mass. State Agricultural College. 1885–90.
1	714	Annual Report of Nebraska State Board of Agriculture. Furmas.
6	782–787	Appendix to Journal of Senate and Assembly, 26th Session.
1	234	Ampelographie Française. Rendu.
1	235	Ampelographie Française. Rendu.
1	967	A Treatise on the Insects Injurious to Fruit and Fruit Trees.
1	221	Annuaire de L'Observatoire de Montsouris pour l'an. 1886.
1	708½	Agriculture of Massachusetts. 1891.
1	412	Annali di Agricultura. 1891.
1	689	Annual Report of State Board of Horticulture.
1	709	Agriculture of Massachusetts. 1892.
1	413	Annali de Agriculture. 1892.
1	495	Analyse de Vin. Robinet.
1	1001	Atlas of the World.
1	736	Arbitration and President's Message.
1	221	Bulletin Météorologique du Department de l'Hérault.
1	250	Bulletin Consulaire Français. 1877. Fascicule. 1–6.
1	251	Bulletin Consulaire Français. 1877. Fascicule. 7–11.
1	252	Bulletin Consulaire Français. 1878. Fascicule. 1–7.
2	253–254	Bulletin Consulaire Français. 1885. Fascicule. 1–12.
2	255–256	Bulletin Consulaire Français. 1886. 1–12. Fascicule. Jan.–Dec.
1	628	Black-Rot.
1	682	Biennial Report of State Board of Horticulture. 1884.
1	683	Biennial Report of State Board of Horticulture. 1885–86.
1	684	Biennial Report of State Board of Horticulture. 1887–88.
1	802	Bulletin of the Wool Manufactures. Hays.
1	933	By-laws Foreign Fruit Exchange of the City of New York. 1885–88.
1	565	Bordeaux and its Wines, by Edouard Feret.
1	47	Culture de la Vigne. J. Guyot.
1	56	Culture de la Vigne. Boireau.
1	65	Culture de la Vigne. Lenoir.
1	74	Culture du Médoc. Joubert.
1	82	Culture du Chasselas. Charmeux.
1	109	Culture de la Vigne dans la Côte d'Or. Cornu.
1	112	Culture de la Vigne Americaine.
1	116	Culture du Chasselas. Roret.
1	118	Calendrier des Vins. Roret.
1	119	Culture de la Vigne. Roret.
1	134	Culture de la Vigne. Persox.

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1	454	Cognac und Weinsprit Fabrikation. Dal Piaz.
1	137	Conseiller du Debitant de Boissons. Du Liege.
1	154	Commission Supérieure du Phylloxera. 1881.
1	155	Comptes Rendus. 1885.
1	158	Coulure du Raisin, La. Baltet.
1	162	Catalogue des Vignes Americaines. Bush et fils et Meissner.
1	190	Commission Supérieure du Phylloxera. 1877.
1	191	Commissao Central dos Servicos Phylloxericos. Villar D'Alle.
1	199	Culture de la Vigne en Chaintres. Vias.
1	408	Construzioni Enotecniche, e Vasi Vinari. Cerletti.
1	512	Cross- and Self-Fertilization in the Vegetable Kingdom. Darwin.
1	523	Catalogue of European Vines. Heyne.
2	553–554	Chemistry of Common Life. Johnston.
1	550	Costa Rica, Her Future. Biolby.
1	737	California Blue Book. 1891.
1	755	Commercial Relations. 1880–81.
1	756	Commerce and Navigation of the United States. 1883.
6	757–762	Commerce and Navigation of the United States. 1885–90.
1	882	Consular Reports. 1880–81.
1	756½	Commerce and Navigation of the United States. 1884.
1	237	Chimie Appliqué à la Viticulture et l'Oenologie. Ladrey.
1	193	Concentration des Mostes in Vac.
1	52	De la Culture des Vignes dans le Medoc. A. d'Armailhacq.
1	86	De l'Action du Froid. Baltet.
1	98	Du Vin. Husson.
1	121	Distillation des Vins. Roret.
1	142	De l'Alcool. Jaillet.
4	174–177	Documents Statistiques sur le Commerce de la France. 1881–84.
2	178–9	Documents Statistiques sur le Commerce de la France. Cerletti. 1886.
1	185	Des Alcools et de L'Alcoolisme. Rabuteau. De L'Alcoolisme et de ses Consequences. Lancereaux.
1	186	Du Debitant de Boissons. Baudrimont.
1	188	D'Entomologie. Lichtenstein.
1	216	Description et Culture des Mûriers. Seringe.
1	453	Die Mittel zur Bekampfung der Reblaus. Bolle. Der Bekampfung der Peronospora. Viticola. Die Wurzellaus des Birnbaums. Goethe.
1	539	Distillation and Rectification of Alcohol. Brannt.
1	558	Descriptive Account of the Wine Industry of Italy. Rossati.
2	270–271	Documents Statistiques sur le Commerce de la France. 1885–86.
1	907	Diseases of Swine and other Domestic Animals. 1879.
1	1006	Dictionnaire Anglais-Français. Clifton & Grineaux.
1	1010	Dictionary of Dates, with American Supplement, Haydn's. Putnam.
1	455	Die Unwerthung der Weinruckstande, by Antonio dal Piaz.
1	998	Directory of Cuba, Puerto Rico, and European Colonies.
1	409	Devincenzi. Della società dei viticulturi, 1884.
1	88	Echauffage des Vin. Giret et Vinas.
13	24–36	Encyclopédie de l'Agriculture.
3	42–44	Etude des Vignobles de France. J. Guyot.
1	69	Etudes sur les Fermentations. A. Gautier.
1	73	Entre Vignerons à la Veillée. Daguillon.
1	117	Eaux et Boissons Gazeuses. Roret.
1	144	Etudes sur les Boissons Fermentées. Boucherie.
1	149	Etudes sur les Peronosporées. Cornu.
1	159	Enquête sur le Peronospora. Congrés Viticole d'Alger.
1	194	Etude sur les Raisins, Le. Canu.
1	213	Etudes sur les Travaux Phylloxeriques et les Vignes Americaines. Laliman.
2	226–227	Etudes sur le Vin. Pasteur.
1	626	Experiments in the Manufacture of Sugar from Sorghum and Sugar-canes. 1887.
1	799	Executive Documents. 1860–61.
1	206	Evolution des Pucerons et du Phylloxera en Particular. Lichtenstein.
25	1012–1036	Encyclopedia Britannica.
4	1037–1040	Encyclopedia Britannica Supplement.
1	101	Fraudes et Maladies du Vin. J. Brun.
1	102	Fabrication des Liqueurs. Tondeur.
2	103–104	Fabrication des Liqueurs. Duplais.
1	124	Fabricant de Levure. Roret.
1	123	Fabricant de Cidre. Roret.
1	125	Fabrication des Engrais. Roret.

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1	143	Fabrication de d'Alcool. Roux.
1	145	Formation des Vegetaux. Chavée Leroy. Fouliers, Pompes, Pressoirs. Pulliat.
1	192	Fillossera in Italia nel 1882, La.
1	513	Facts about Port and Madeira. Vizetelly. (Sent to U. S. Int. Rev. Dept., [1892.
1	517	Franco-American Commerce.
1	535	Facts about Champagne and other Sparkling Wines. Vizetelly.
1	538	Facts about Sherry. Vizetelly.
1	542	Fermentation. Schutzenberger.
1	627	Forest Conditions of the Rocky Mountains. 1888.
1	880	Finance Reports. 1883.
1	563	Fruit-Culture in Foreign Countries. 1890.
1	569	Fruit-Growing and Agriculture.
1	207½	Fungi Italici.
1	8½	
1	9½	
1	10½	
1	11½	
1	12½	
1	13½	
3	48–50	Guide du Fabricant d'Alcools. N. Bassett.
1	64	Générations des Ferments. Fremy.
1	83	Guide du Vigneron. Lacoste.
1	181	Grafting. Champin.
1	204	Grande Culture de la Vigne Americaine. Duchesse de Fitzjames.
1	211	Grafting.
6	400–405	Grevillea. M. C. Cooke.
1	414	Genera Pyrenomycetum. Saccardo.
1	505	Guide to the Study of Insects. Packard.
1	507	Grape-Culture, Wines, and Wine-Making. Haraszthy.
1	549	Grape-Culture and Wine-Making, California. Husmann.
1	1008	German and English Dictionary. Adler.
1	671	Gauger's Weighing Manual. 1892.
1	980	Grape-Training. Bailey.
1	147	Histoire des Insects Nuisible la Vigne. Audouin.
2	520–521	Handbook of British Fungi. Cooke.
1	530	Harris' Insects Injurious to Vegetation. Flint.
1	536	Handbook to Victoria.
1	712	Hatch Experiment Station.
1	912	Historical Sketch of State Normal School.
1	561	Handbook of the American Republics, Vol. I.
1	562	Handbook of the American Republics, Vol. II.
1	500	History of American and Modern Wines.
1	502	History of Champagne. Vizetelly.
1	526	Insects et Mollusques Ennemis de la Vigne. Petis-Lafitte.
1	526	Insects Injurious to Forest and Shade Trees. Packard.
1	528	Injurious Insects of the Orchard, Vineyard, etc. Cooke.
1	529	Insects, Injurious and Beneficial. Cooke.
1	531	Insects Injurious to Fruits. Saunders.
1	532	Index to Missouri Entomological Commission.
1	560	Insects Injurious to Fruit and Fruit Trees of California.
1	763	Internal Commerce of the United States. 1882.
1	764	Internal Commerce of the United States. 1884.
1	765	Internal Commerce of the United States. 1886.
1	766	Internal Commerce of the United States. 1887.
1	908	Investigation Committee of the Bureau of Labor Statistics.
1	937	International American Conference, Reports and Recommendations.
1	966½	International Commerce of the United States. 1889.
1	988	Import Duties of Central and South America.
5	262–266	Journal de l'Agriculture. 1884–1888.
8	13–20	Le Verger. Mas.
3	21–23	Le Vignoble. Mas et Pulliat.
1	51	La Fermentation. N. Bassett.
1	53	La Vigne. Petit-Lafitte.
1	63	La Fermentation des Vins. Gentil.
1	66	Les Vignobles. Dubreuil.
1	67	Le Vigneron Provençal. Pellicot.
1	70	La Sophistication des Vins. Gautier.

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1	75	Les Vins. Joubert.
1	76	La Vigne en Chaintres. Hemmer.
1	77	Le Mildiou. Foëx et Viala.
1	92	Les Raisins Secs. Audibert.
1	96	Le Vin. Vergnette-Lamotte.
1	100	Les Vins Exotiques. Sempe.
1	107	Les Ravageurs des Vergers et des Vignes. La Blanchère.
1	108	La Vigne et le Vin. Burdel.
1	160	Le Privilège de Vigne.
1	111	Le Phylloxera. Mouillefert.
2	113–114	Les Vignes Americaines.
1	133	Les Vignes Americaines. Millardet.
1	135	Le Parfait Maitre de Chai. Pevroux.
1	139	La Distillation. Déon.
1	153	Le Phylloxera et les Cultures Profondes. Ibarrart.
1	182	Les Boissons, Fermentées. Boucherie.
1	197	Le Phylloxera Expliqué. Gagnat.
1	201	Le Soufrage de la Vigne. Vergne.
1	202	Les Vins du Siecle dans la Gironde. Trois Etoiles. La Sophistication des Vins. Gautier.
1	203	La Coulure de la Vigne. Troubat.
1	208	Les Insecticides et les Cepages Resistants. Guerin.
1	210	Le Phylloxera. Mouillefert.
1	217	La Question des Vignes Americaines. Millardet.
1	218	Les Vignes Americaines et les Vignes Françaises. Cauvy.
1	220	Le Phylloxera dans Libourne. Lacroix.
1	223	Les Vignes Americaines. Sazille.
1	537	Lacour on the Manufacture of Liquor.
1	260	La Vigne Française. 1887.
1	735	Laws of Illinois. 1889.
1	570	Life and Public Service of Oliver P. Morton.
1	150	Le Phylloxera.
5	37–42	Maison Rustique du XIX Siecle.
1	80	Maladies de la Vigne. Serigne.
1	81	Manuel de Viticulture. Foëx.
1	84	Maladie de la Vigne. Bouchardat.
1	94	Manuel des Vins. Robinet.
1	99	Méthode de Vinification. Aubergier.
1	115	Manuel du Negociant. François.
1	126	Manuel d'Alcoolmetrie. Roret.
1	127	Manuel du Distillateur. Roret.
1	128	Manuel du Sommelier. Roret.
1	129	Manuel du Tonnelier. Roret.
1	130	Manuel du Vinaigrier. Roret.
1	131	Manuel du Vigneron. Roret.
1	132	Monographie des Greffes. Roret.
1	140	Manuel de la Distillation. Stammer.
1	141	Manuel des Distilleries. Peroche.
1	157	Maladies de la Vigne. Delfrau.
1	161	Mission Viticole en Amerique Viala. (See 208.)
1	163	Mélanges. Ch. Joly.
1	184	Mémoire sur la Maladie. Trimoulet.
1	220½	Manuel du Vigneron.
1	212	Manuel du Greffeur de Vignes. Pulliat.
2	406–407	Michelia, P. A. Saccardo.
1	522	Manual of Qualitative Chemical Analysis. Fresenius.
1	259	Mémoires sur la Sericulture. 1874, 1877.
1	715	Michigan Board of Agriculture, 1884. Baird.
1	728	Montreal Horticultural Reports. 1884–85–86.
1	729	Minnesota State Horticultural Society. 1889.
1	734	Michigan Horticultural Society. 1886.
1	801	Municipal Reports. 1880–81.
1	1009	Micrographic Dictionary. Griffith & Henfrey.
1	743	Manufacture and Distillation of Alcoholic Liquors.
1	567	Mida's Directory of Retail Liquor Dealers of Illinois, Part I.
1	236	Ministère de l'Agriculture.
1	716	Michigan Board of Agriculture. 1890–91.

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1	980	Message and Document. 1853.
5	981–985	Message and Document. 1881–1885.
1	120	Negociant d'Eau de Vie. Roret.
1	214	Notes sur les Vignes Americaines. Millardet.
1	713	Nevada Agricultural Experiment Station Bulletin, 2–6.
1	938	North Carolina Agricultural Experiment Station, Bulletin 76.
1	564	New Zealand Grapevine Manual. Chapman.
1	72	Oenologie Française Caroleau.
1	506	Origin, Nature, and Use of Wine. Thudichum & Dupré.
1	524	Olive Culture. Pohndorff.
1	687	Official Report of the Tenth Fruit-Growers' Convention, State of California. 1889.
1	566	Orange Culture in New Zealand.
1	568	Olive Culture, etc.
1	973	Official Report of the Ninth Fruit-Growers' Convention of California. 1888.
1	875	Original Copy of Awards for Viticulture at Columbian Exposition.
12	1–12	Pomologie Generale. Mas.
1	79	Plantes Americaines. Courty.
1	60	Phylloxera, Le. Ladrey.
1	195	Phylloxera Detruit et la Vigne Régénérée, Le. Rexes. Progrès de la Maladie de la Vigne. Mares. Vigne Americaine et la Viticulture en Europe, La. Llamhon.
1	156	Phylloxera; Commission Départmentale de l'Hérault.
1	207	Phylloxera. Rohart.
1	219	Phylloxera et les Vignes de l'Avenir. Guerin.
1	410	Processos de Vinificaçao.
1	533	Practical Farm Drainage. Elliott.
1	540	Practical Distiller. Byrn.
1	545	Practical Brewer.
10	786–797	Patent Office Reports. 1850–59.
1	798	Patent Office Reports. 1861.
1	180	Pamphlets on Phylloxera (bound).
1	901	Proceedings of State Irrigation Convention. 1886.
1	909	Proceedings of the National Convention. 1887.
1	412	Plinius Secundus. Historia Naturalis.
1	138	Quatre Ans de Luttes pour nos Vignes et nos Vins. Du Liège.
1	151	Recherches sur le Phylloxera Vastatrix. Institut de France.
1	200	Remedies for Phylloxera. Mouillefert.
1	215	Rapport de la Commission des Vignes Americaines.
1	514	Redding on Wines.
1	519	Raisin Industry, The. Eisen.
1	544	Report on Cheap Wine. Druitt.
8	600–606	Report of the Commissioner of Agriculture. 1862–69.
1	607	Report of the Department of Agriculture. 1870–71.
6	608–613	Report of the Department of Agriculture. 1874–79.
6	614–619	Report of the Department of Agriculture. 1883–88.
6	620–625	Report of Statistician, Department of Agriculture. 1884–1890.
1	629	Report of Secretary of Agriculture. 1890.
1	680	Report of Horticultural Commissioners. 1882.
1	731	Report of Ohio State Horticultural Society. 1883–87.
1	738	Report of the State Board of Equalization. 1890.
5	750–754	Revised Statutes of the United States. 1878.
1	768	Report of the Chief of Bureau of Statistics. 1881–82. Quarterly.
9	769–778	Report of the Chief of Bureau of Statistics. 1881–90.
1	800	Report of Chief Signal Officer, War Department. 1880.
1	804	Report of Insurance Commissioner. 1871.
1	805	Report of Insurance Commissioner. 1873.
3	806–808	Report of Insurance Commissioner. 1883–85.
2	809–810	Report of Insurance Commissioner. 1880–81.
4	811–814	Report of Insurance Commissioner. 1887–90.
1	820	Report of Industrial Exhibition, Mechanics' Institute.
1	821	Report of the Adjutant-General. 1890.
1	823	Report of California State Board of Health. 1870–71.
1	824	Report of California State Board of Health. 1877–79.
1	825	Report of California State Board of Health. 1876–77.
18	830–847	Report of Com. Int. Rev. 1863–80.
9	848–855	Report of Com. Int. Rev. 1882–90.
13	860–872	Report of State Viticultural Commission. 1880–90. (In pamphlet form.)
1	884	Report on Cotton Insects. 1879. Comstock.

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1	885	Report of Commissioners of Indian Affairs. 1884.
2	886–887	Report of Commissioners of Indian Affairs. 1882–83.
6	888–893	Report of State Mineralogist. 1884–87.
1	894	Report of State Mineralogist. 1889.
1	895	Report of State Mineralogist. 1890.
1	896	Report of Bureau of Labor and Statistics. 1887–88.
1	897	Report of Bank Commissioners. 1885.
2	898–898½	Report of Bank Commissioners. 1889–90.
1	900	Report of Board of Railroad Commissioners. 1886.
1	902	Report of Pennsylvania State College. 1889.
1	903	Report of Board of Forestry. 1887–88.
1	910	Revised Statutes of Illinois.
1	911	Report of Mechanics' Institute. 1884.
1	931	Report of Interstate Commerce Commission. 1888.
1	934	Report of U. S. Entomological Commission on the Rocky Mountains. 1880.
1	935	Report of Secretary of Agriculture. 1890.
1	628½	Report of Secretary of Agriculture. 1889.
2	970–971	Report of U. S. Fish Commission. 1881–82.
1	625½	Report of Animal Industry. Department of Agriculture.
1	972	Report of U. S. Consuls. 1881–83.
1	974	Report of the Interstate Commerce Commission. 1891.
1	976	Report of Department of Agriculture of South America.
1	978	Report of Secretary of Agriculture.
1	899½	Report of Bank Commissioners of California. 1892.
1	986	Report of State Mineralogist.
1	987	Report of State Mineralogist, 7th Annual.
1	991	Report of Bureau of Statistics, quarterly.
1	992	Report of Department of Agriculture, California Vine Diseases.
1	993	Report of Department of Agriculture, Insect Life.
1	994	Report of Department of Agriculture, Treatment of Plant Diseases.
1	996	Report of Public Schools.
1	997	Report of Commissioners of Internal Revenue. 1892.
1	987½	Report of State Mineralogist. 1892. 11th Report.
1	698	Report of State Controller.
1	893½	Report of State Mineralogist. 1888.
1	913	Report of University of California. 1879.
1	71	Statistique de la Vigne. Morelot.
1	78	Submersion des Vignes. Ambroy.
1	93	St. Emilion et ses Vins.
1	189	Sur la Viticulture de la Charente-Inférieure. Guyot.
1	196	Submersion for Phylloxera. Faucon.
1	205	Submersion. Ambroy.
2	407½ *a, b.*	Sylloge Fungorum. Saccardo.
1	556	School for American Grape Culture. Muench. [American Com. Treaty.
1	559	Statements in behalf of American Industries against the proposed Franco-
1	936	Statistical Abstract of the United States. 1883–88.
1	742	Statistics of Railways in the United States.
1	857	Sweet Wine Regulations.
1	54	Traitement des Vins. Boireau.
1	61	Traité de Vinification. Dubief.
1	62	Trésor des Vignerons. Dubief.
1	68	Travail des Vins. Maumené.
1	136	Théorie des Pése Liqueurs. Benvit.
1	152	Traitement des Vignes Phylloxerées par le Sulfure de Carbon. Marion.
7	164–169	Traité de Chimie. Pelouze et Fremy.
2	170–71	Tableau General du Commerce de la France. 1867–76.
2	172–173	Tableau General du Commerce de la France. 1876 and 1877.
1	503	The Olive. Marvin.
1	508	The Liquor Problem in all Ages. Forchester.
1	509	The Grapevine. Meredith.
1	510	The Wine Press and the Cellar. Rixford.
1	525	The Western Catalpa. Cusin.
1	541	The Grape Culturist. Fuller.
1	546	The Viniculture of Claret. Bleasdale.
1	547	The Ramrod Broken.
1	630	Transactions of California State Agricultural Society. 1868–69.
20	650–669	Transactions of California State Agricultural Society. 1866 to 1889.
6	700–705	Transactions of Department of Agriculture, Illinois. 1876–81.

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No. of Vols.	Number.	
9	718–726	Transactions of Massachusetts Horticultural Society. 1880–88.
1	730	Transactions of Maine Pomological Society. 1887–88.
1	881	Tariff Compilation. 1884.
2	224–225	Tariff Official des Douanes de France, Parts I and II.
6	1041–1046	The Riverside Natural History.
3	228–230	Traité de la Vigne. L. Portes and F. Ruyssin.
1	740	Tenth Census of the United States. Statistics of Agriculture.
2	231–232	Travail des Vins. Maumené. Vols. 1 and 2.
1	236	Traité Pratique des Vins. M. Paul Le Lourd.
1	670	Transactions of the California State Agricultural Society. 1891.
1	999	Transactions of the Massachusetts Horticultural Society, Parts I and II.
1	572	Treatise on Wines. By Thudichum.
1	672	Transactions of the California State Agricultural Society.
1	999*a*	Transactions of Massachusetts Horticultural Society, Parts I and II. 1889.
1	999*b*	Transactions of Massachusetts Horticultural Society, Parts I and II. 1890.
1	999*c*	Transactions of Massachusetts Horticultural Society, Parts I and II. 1892.
1	548	The Gauger's Manual.
1	917	University of California.
1	919	University of California Viticultural Work. 1886.
2	920–921	University of California Viticultural Work. 1887–88.
1	922	University of California Water Supply. 1888–89.
1	923	University of California. 1879–89.
1	924	University of California. 1891.
2	925–926	University of California. 1890. [Hilgard.
1	927	University of California. 1886. Alkali Lands, Irrigation and Drainage.
4	1002–1005	Urés Dictionary.
1	1011	United States Dispensatory.
1	915	University of California. 1880.
1	744	United States Department of Agriculture. Insect Life. 1890.
1	745	United States Department of Agriculture. 1891.
1	989	University of California. Method of Fermentation.
1	990	University of California. Agricultural Work.
1	930	United States Document Code of California.
1	527	University Papers. [1, 2, and 3d.
1	904	Victoria Royal Commission on Vegetable Products. Report Progress,
1	905	Victoria Royal Commission on Vegetable Products. [and 8th.
1	906	Victoria Royal Commission on Vegetable Products. Report Progress, 7th
1	45	Viticulture de l'est de la France. J. Guyot.
1	46	Viticulture du sud ouest de la France. J. Guyot.
2	57–58	Viticulture et Oenologie. C. Ladrey.
1	105	Vin de Bordeaux. Carles.
1	106	Viticulture de L'Anjon. Borit.
1	209	Viticulture. Foex.
1	222	Viticulture in Eastern France and the Charentes. Guyot.
1	571	Vine and Vine-Growers.
2	450–451	Weinbau und Kellerwirthschaft. Babo u. Mach.
1	504	Wine, the Vine, and the Cellar. Shaw.
1	534	Wine and its Counterfeits. Denman.
1	543	Woodward's Graperies and Horticultural Buildings. Woodward.
1	551	Wines and Other Fermented Liquors. Sheen.
1	502	Wines of the World, The. Vizetelly.
1	1000	Webster's Encyclopedic Dictionary.
		Additional.
1	110	La Lutte Contre le Phylloxera. Barral.
1	198	Pamphlets on Phylloxera.
1	501	Barry on Wines.
1	688	Annual Report of State Board of Horticulture. 1890.
1	741	10th Census, U. S.
1	916	University Document.
1	990	University Document.
1	995	Viticultural Commission Document.
1	803	Report of Insurance Commissioner.
1	----------	Agricultural Features of California. Hilgard.
1	----------	Carte du Department de la Giornde.
1	6001	Report of State Board of Examiners. 1895.
1	6002	Biennial Report of State Controller. 1893–94.
1	6003	Governor Markham's Message.

Inventory of Property of State Board of Viticultural Commissioners—Library—Continued.

No. of Vols.	Number.	
1	6004	Redwood. Ammonia refrigeration.
1	6005	Report of Secretary of Agriculture. 1892.
1	6006	San Francisco Municipal Reports. 1891-92.
1	6007	California Bank Commissioners' Report. 1895.
1	6008	Commerce and Navigation of United States. 1894.
1	6009	U. S. Department of Agriculture (Yearbook). 1894.
1	6010	Report of Secretary of Agriculture. 1892.
1	6011	Production of Gold and Silver.
1	6012	Agriculture of Massachusetts. 1893.
1	6013	Fourth Biennial Report of State Board Horticulture. 1894.
1	6014	Bank Commissioners' Report. 1893.
1	6015	Report of Agricultural Experiment Stations. 1893-95.
1	6016	Report of Commissioner of Internal Revenue. 1894.
1	6017	Report of Commissioner of Internal Revenue. 1893.
1	6018	Report of Commissioner of Internal Revenue. 1892.
1	6019	California at Columbian Exposition. 1893. (2 vols.)
1	6020-6023	Commerce and Navigation of United States. 1891-93.
1	6024	Agriculture of Massachusetts. 1894.
1	6025	Commerce and Navigation of United States. 1891.
1	6026	Internal Commerce of United States. 1890.
1	6027	Index to Agriculture of Massachusetts. 1837-92.
1	6028	Trans. Iowa Horticulture Society. 1881.
1	6029	Grape Culture and Wine-making. 1886.
1	6030	Report of Agricultural Experiment Station, University of Wisconsin. 1893.
1	6031	California Blue Book. 1893.
1	6032	Animal Parasites of Sheep.
1	----------	Bureau of Animal Industries. 1887-88.
1	6034	Swine Plague, Report on.
1	6035	Hints on Dairying.
1	6036	Western Brokers' Directory.
1	6037	Commerce and Navigation of United States. 1890.
1	6038	Commerce and Navigation of United States. 1885.
1	6039	Commerce and Navigation of United States. 1890.
1	6040	Commerce and Navigation of United States. 1884.
2	6041-6042	Commerce and Navigation of United States. 1892.
1	6043	Commerce and Navigation of United States. 1890.
1	6044	Commerce and Navigation of United States. 1889.
1	6045	Commerce and Navigation of United States. 1891.
2	6046-6047	Commerce and Navigation of United States. 1883.
1	6048	Commerce and Navigation of United States. 1890.
1	6049	Evans, Imports and Duties.
1	6050	Report of Commissioner of Internal Revenue. 1894.
1	6051	Report of Commissioner of Internal Revenue. 1888.
1	6052	International American Conference.
1	6053	International Commerce of United States. 1882.
3	6054-6056	International Commerce of United States. (1 of 1889.)
2	6057-6058	International Commerce of United States. 1885-86.
1	6059	Report of Commissioner of Education. 1882-83.
2	6060-6061	Commerce and Navigation of United States. 1886 and 1852.
1	6062	Tariff Compilation. 1884.
1	6063	Third Annual Report of California Railroad Commissioners. 1880-81-82.
2	6064-5	U. S. Department of Agriculture, Report on Sheep Industry. 1892.
5	6066-70	Report of Commissioner of Internal Revenue. 1888 and 1890.
1	6071	Department of Agriculture Report. 1884.
1	6072	Department of Agriculture Report. 1886.
1	6073	Department of Agriculture Report. 1887.
1	6074	Department of Agriculture Report. 1883.
1	6075	Department of Agriculture Report. 1884.
1	6076	Department of Agriculture Report. 1884.
1	6077	Department of Agriculture Report. 1888.
1	6078	Department of Agriculture Report. 1887.
1	6079	Department of Agriculture Report. 1884.
1	6080	Department of Agriculture Report. 1888.
1	6081	Agriculture of Massachusetts. 1893.
1	6082	Agriculture of Massachusetts. 1891.
2	6083-4	Report on Diseases of Cattle. 1892.
1	6085	Tariff Compilation. 1884.
1	6086	Smithsonian Report. 1882.

INVENTORY OF PROPERTY OF STATE BOARD OF VITICULTURAL COMMISSIONERS—LIBRARY—Continued.

No. of Vols.	Number.	
1	6087	Smithsonian Report. 1883.
1	6088	Annual Report of Railroad Commission. 1884.
1	6089	Third Annual Report of Interstate Commerce Commission. 1889.
1	6090	Third Annual Report of Interstate Commerce Commission. 1889.
1	6091	Report of Fruit-Growers' Convention. 1889.
1	6092	Biennial Report of State Board of Horticulture. 1887-88.
2	6093-4	Report of Commissioner of Internal Revenue. 1889.
1	6095	Report of Bank Commissioners of California. 1891.
1	6096	Production of Gold and Silver in United States. 1893.
3	6097-8-9	Secretary's Report of Agriculture. 1889-90-91.
4	6100-1-2-3	Secretary's Report of Agriculture. 1889-90-91.
1	6104	Secretary's Report of Agriculture. 1893.
1	6105	Municipal Report San Francisco. 1889-90.
1	6106	Report of U. S. Entomological Commission. 1880-82.
1	6107	Foreign Relations of United States. 1883.
1	6108	Transactions California State Agricultural Society. 1884.
3	6109-10-11	Transactions California State Agricultural Society. 1887-88.
2	6112-13	Annual Report of California State Board of Horticulture. 1891-92.
1	6114	Report of California Bank Commissioners. 1894.
1	6115	Report of Railroad Commissioners. 1893.
1	6116	Report of United States Internal Commerce. 1891.
1	6117	Annual Report of State Board of Horticulture. 1883.
1	6118	Handbook of American Republics, Vol. I.
1	6119	Handbook of American Republics, Vol. II.
1	6120	U. S. First Controller's Decisions. 1884. Vol. V.
1	6121	Eleventh Report of State Mineralogist. 1892.
2	6122-3	Report of Commissioners of Internal Revenue. 1893-94.
2	6124-5	U. S. Statistical Abstract, 17th No. 1894.
1	6126	California Blue Book. 1891.
9	6127-6135	Fourth Biennial Report of State Board of Horticulture. 1893-94.
		Bound Periodicals.
22	----------	Pacific Rural Press.
4	----------	Western Broker.
23	----------	Bonfort's Wine and Spirit Circular.
13	----------	California Fruit-Growers.
5	----------	Wine and Spirit Review (Eastern).
2	----------	Midas Criterion.
1	----------	Herald of Trade.
1	----------	Wine and Spirit Bulletin.
6	----------	Rural California.
2	----------	Ridley & Co.'s Circular.
10	----------	San Francisco Merchant.
8	----------	Pacific Wine and Spirit Review.

About 20,000 miscellaneous reports of the Viticultural Commission, and others.

RECAPITULATION.

515 articles in main office.
937 books in Library.
About 20,000 miscellaneous reports of Viticultural Commission and others, in pamphlet form.
162 missing articles, with miscellaneous laboratory apparatus unnumbered.
44 missing books.
15 wire frames in Arizona warehouse

The following named books were reported as missing:

No. of Vols.	Number.	
1	943	Commerce between United States and Mexico.
1	688	Annual Report of State Board of Horticulture. 1890.
1	950	Cornell University, Tomatoes.
1	951	Cornell University, On Effect of Grain Ration for Cows at Pasture.
1	952	Cornell University, XXV.
1	952½	Cornell University, Bulletin 29.
1	953	Cornell University, Bulletin 30.
1	962	Classification and Synopsis of the Wild Grape of N. A.
1	148	Etudes sur le Phylloxera Vastatrix. Andouin.
1	963	Horticulture. George W. Campbell.
1	979	International Commerce of United States. 1891.
1	146	La Vigne. Bertall.
1	955	Mich. Agr. Ex. Stations.
1	989	Method of Fermentation.
1	964	North Carolina Agr. Ex. Stations.
1	969	Olive Culture in the Alps Maritimes.
1	938	Proceedings of Georgia State Horticultural Society. 1890.
1	961	Production, Consumption, etc., of Spirituous and Malt Liquors and Wines.
1	516	Rudiments of Grape Culture. Eakin
1	777	Report of Chief of Bureau of Statistics. 1888.
1	780	Report of Chief of Bureau of Statistics. September, 1890.
1	781	Report of Chief of Bureau of Statistics. March, 1891.
1	822	Report of Park Commissioners. 1890.
1	899	Report of Park Commissioners. 1891.
1	940	Report of Chief of Bureau of Statistics on Foreign Commerce of U. S.
1	941	Reports from Consuls of United States. 1890.
1	942	Report on the Fungous Diseases of the Grapevine. Scribner.
1	960½	Regulations Concerning Analyses of Foods and Drugs.
1	965	Report of Statistician, Dept. of Agr. 1891.
1	738½	Report of State Board of Equalization. 1891.
1	975	Report of Chief of Bureau of Statistics, Treasury Department. 1891.
1	977	Report from Department of Agriculture, Food and Food Adulteration.
1	734	Supplement to Revised Statutes of United States, 1874. 1881.
1	727	Transactions of Massachusets Hort. Society. 1889.
1	732	Transactions Iowa Hort. Society. 1881.
1	739	Laws of Vermont Relating to Illegal Sale and Use of Intoxicating Liquors. [Porter.
1	917	The Phylloxera on Grapevine. Sousé.
1	959	Treatment of Plant Diseases.
1	966	Annali di Agricultura. 1886.
1	197	Guide du Vigneron. Crolas & Vermorel.
1	955	Michigan Agr. Experiment Station. Kedzie.
1	883	Report of Bank Commissioners. 1890.
1	932	Report of Interstate Commerce Commission. 1889.

From incomplete notes taken in the Controller's office, and the inventory furnished by Secretary Bonté, it appears that the following articles are not accounted for. These articles are of such a nature that it is not reasonable to suppose that they could have disappeared utterly:

1884	No. 132	1 calorimeter	$150 00
Oct., 1891	No. 4749	1 ice-chest	115 00
Sept., 1889	No. 9785	1 photographic lens	40 00
Mar., 1887	No. 12359	1 microscope	25 00
Mar., 1886	No. 6304	1 ice-chest	16 00
June, 1881	No. 176	Agate mortar, retort, and stand	5 00
1884		4 doz. pieces laboratory glassware. (Some ought to exist)	10 00
1884		Miscellaneous laboratory apparatus	58 00
1884	No. 3440	1 iron loaming plate	10 00
1884	No. 1201	1 copper water-bottle and miscellaneous laboratory apparatus	54 00
Jan., 1886	No. 5161	Gas apparatus for laboratory	22 00
Dec., 1884	No. 3481	1 retort and 24 demijohns	21 50
Jan., 1886	No. 5161	Miscellaneous laboratory apparatus	125 00
		Gas outfit for laboratory (apparatus)	76 00
		21 hydrometers. (13 bought August 9, 1888, No. 1170)	54 00
		37 thermometers	105 00
1884	No. 2688	1 grape-crusher. (Either October or December)	45 00

Oct., 1884	No. 2091	Pulp presses, tubs, kegs. (January, 1885, No. 4249)	$62 00
July, 1887	No. 4229	Barrels and fermenting funnels. (Part October, 1885, No. 2734)	45 00
Jan., 1886	No. 5161	Saw, hatchet, and bucket	25 00
Jan., 1886	No. 5161	Hand-corker and bung-starter	6 10
Mar., 1887	No. 12359	Iron pot and kettle	9 95
Oct., 1887	No. 4229	40-ft. skid for moving barrels. (Imperishable)	20 00
1887	No. 15876	1 spray pump. (Month between May and July)	13 50
1888	No. 13744	Bottle-tubs. (Good for twenty years. Have not the month; think February)	25 00
Aug., 1888	No. 3700	Bottle-washer. (Imperishable)	50 00
Aug., 1888	No. 3700	Capping machine. (Ought to last twenty-five years)	18 00
Apr., 1888	No.	7 stoves. (1 cost $150; No. 15432 for $150)	222 00
Oct., 1890	No. 3729	4 metal chandeliers	65 00
			$1,493 05

While it is possible that much of this would be destroyed in the ordinary laboratory work, it is impossible to destroy so much, with ordinary care. The calorimeter, photographic lens, microscope, etc., certainly ought to be in good condition. The others were found to be, so it is reasonable to suppose that these ought to be, too.

The difference in laboratory apparatus, as shown by first inventory and second, is $1,299, leaving $1,493 05 to be found. It is to be noted that the notes that were taken in the Controller's office were very incomplete, and the difference is really more than $1,493 05.

(Unofficial.)

San Francisco, January 16, 1896.

Rev. J. H. C. Bonté, *Berkeley, Cal.:*

Dear Sir: I have your letter of the 10th inst., inclosing copy of a letter from the Secretary of the State Board of Examiners, with a list of articles, the property of the Viticultural Commission, alleged by you to be missing.

Under the advice of my attorneys, I request you to send me at once a statement of the date at which each of such articles became the property of the Commission. You must understand that I have been Secretary of this Board but five years, and that there were previous Secretaries, to wit: Dr. John I. Bleasdale (now dead), John H. Wheeler, C. J. Wetmore, and Charles B. Turrill.

When I took the position in 1890, no property was ever formally turned over to me, nor did I give a receipt for any property. I know that I have complied, as far as possible, with the terms of the recent Act of the Legislature directing the Board to turn over its property on the 31st of December to the Board of Regents.

I have, however, instituted a personal inquiry in regard to some of these alleged missing articles. From Mr. C. J. Wetmore, who was formerly Secretary of the Board, and who had charge of the experimental cellar till it was abandoned in 1893, and who has always had charge of the financial affairs of the Commission since I went into office in 1890, I have obtained the following statements so far as he is able to give them:

Item 1. "One calorimeter, $150." Mr. Wetmore says he never saw this, and that it is possible that you have mixed it with the calorimeter already turned over to you.

Item 2. "One ice-chest, $115." Mr. Wetmore says that this was not properly an ice-chest, but was virtually a permanent set of frames built into the wall at 317 Pine Street. When we moved to Bush and Sansome streets, at which time I was East, the same was abandoned. It could not be moved in its entirety.

Item 3. "One photographic lens, $40." Mr. Wetmore says this was purchased for W. B. Rising of the University, and turned over to him.

Item 4. "One microscope, $25." Mr. Wetmore says that this was stolen from Platt's Hall before we ever moved to Pine Street, and before my incumbency in the office.

Item 5. "One ice-chest, $16." Mr. Wetmore says that this was sent to Chicago, to the World's Fair, and was there abandoned, as it had become leaky and useless and was not worth paying the freight back on.

Item 6. "Agate mortar, retort, and stand."
Item 7. "Four dozen pieces laboratory apparatus (some ought to exist), $10."
Item 8. "Miscellaneous laboratory apparatus, $5."
Item 9. "One iron loaming plate, $10."
Item 10. "One copper bottle and miscellaneous laboratory apparatus, $54."

Mr. Wetmore says that these lots were purchased for Prof. Rising before Mr. Scott was ever elected Secretary of the Commission, and that the apparatus has undoubtedly been used up. You will undoubtedly recollect that Prof. Rising was under pay of the Board for special work in analyzing wines, together with Mr. Morse and Mr. Grandjean. This apparatus, if it exists, is still in Prof. Rising's possession.

Item 11. "Gas apparatus for laboratory, $22." Mr. Wetmore says that this was in 204 Montgomery Street before Mr. Scott was elected Secretary, and that it was abandoned at the time the Board moved to Platt's Hall. The apparatus could not be moved.

Item 12. "One retort and 24 demijohns, $21 50." Mr. Wetmore says that the retort was broken, and the demijohns sent to different parties throughout the State for experimental work.

Item 13. "Miscellaneous laboratory apparatus, $125." Mr Wetmore says this was for Prof. Rising.

Item 14. "Gas outfit apparatus for laboratory, $76." Mr. Wetmore says that this was in the laboratory at 204 Montgomery Street, and became worn-out and useless.

Item 15. "21 hydrometers, $34."

Item 16. "37 thermometers, $105." Mr. Wetmore says that these lots were purchased as far back as the incumbency of Mr. Wheeler in the secretaryship, and were sent to the different viticultural inspectors throughout the State for making investigations.

Item 17. "One grape-crusher, $45." Mr. Wetmore has reported upon this in the statement on file with the Board of Examiners.

Item 18. "Bottling process, tubs, and kegs, $62." Same remarks as to item 17.

Item 19. "Barrels and fermenting funnels, $45." Same remarks as to item 17.

Item 20. "Saw, hatchet, and bucket, $25." Mr. Wetmore says worn-out.

Item 21. "Hand-corker and bung-starter, $6 10." Same remarks as to item 17.

Item 22. "Iron pot and kettle, $9 95." Mr. Wetmore says rusted out and became worthless.

Item 23. "Forty-foot skid for moving barrels (imperishable), $20." Mr. Wetmore says that this skid was not for moving barrels, but for placing barrels on when stored. After the experimental cellar was broken up, it was used for old lumber and kindling.

Item 24. "One spray pump, $13 50." Mr. Wetmore says lost.

Item 25. "Bottle tubs (good for twenty years), $25." Mr. Wetmore says that they were left in Platt's Hall, and could not be taken out without tearing out part of the building.

Item 26. "Bottle-washer (imperishable), $50." Mr. Wetmore says that this bottle-washer would not work, and after moving it from place to place on three occasions, he finally gave a man 25 cents to take it away.

Item 27. "Capping machine (ought to last twenty-five years), $18." Same remarks as to item 17.

Item 28. "Seven stoves (one cost $150), $225." Mr. Wetmore says that six of these stoves were gas stoves, which became worn-out and were abandoned. He says that the stove which you state cost $150 was a furnace, in regard to which the remarks on item 10 apply.

Item 29. "Four chandeliers, $65." Mr. Wetmore says that when Platt's Hall was torn down, an effort was made to get these out of the building to dispose of them to some advantage. They had been used in the large room where the main exhibit was, and finally when the building was torn down, they were abandoned.

Very truly yours,

WINFIELD SCOTT.

BERKELEY, January 21, 1896.

DR. J. H. C. BONTÉ, *Secretary University of California:*

DEAR SIR: In answer to your request for an explanation of the letter of Winfield Scott, Secretary of the Board of Viticultural Commissioners, I beg leave to submit the following:

For a number of years I was requested by the Commission to investigate certain questions and to make certain analyses, etc., as provided by law creating the office of State Analyst. I was allowed to choose an assistant, who worked under my direction. The Commission was liberal in supplying the State Analyst with apparatus and necessary reagents. Mr. Granjean, who was my first assistant, frequently did work in the San Francisco office of the Commission, and applied to Mr. Wetmore for supplies, so that I only knew that certain supplies had been furnished upon seeing the same in my laboratory. I will add that I was always willing to receive as much in the way of new apparatus, reagents, etc., as possible. No receipts were asked for from me. I will add that I am very sure that at different times a considerable amount of reagents were bought by the Commission and consumed in the laboratory in carrying out the work of their planning.

In regard to Item No. 3, I cannot remember ever seeing or using the same.

Items 6, 7, 8, 9, 10, and 13 are too vaguely described to respond to. I may have had pieces of the same and used them, and when worn-out thrown them away. This is true of reagents, I know, and, to a limited extent, may be true of certain pieces of apparatus.

In my report upon apparatus, I have receipted for every piece which I could find in the chemical laboratory at the present time. I realize that it is nearly sixteen or seventeen years since I began investigations for the Commission, and during this time have used many pieces of apparatus which I cannot now recall. I have tried in the above to present as truthful a picture of my relations to the Commission as I was able to.

I am, very truly yours,

W. B. RISING.

SAN FRANCISCO, February 5, 1896.

MR. J. H. C. BONTÉ, *Berkeley, Cal.:*

DEAR SIR: Answering your favor of the 30th ult., can only say that much of the apparatus you find missing from the Viticultural inventory, was purchased under my direction while with the Commission. Much of it, too, disappeared under the use of myself and assistants in the way of glassware, gas fixtures, which had to be left with the offices abandoned, and other articles of a perishable nature.

As my term as Secretary expired in 1887, I am unable to state what part of the missing articles were turned over to my successor, Mr. C. J. Wetmore, but remember that very little, if any, important apparatus was lost or stolen; a small microscope and, I think, an objective were stolen and perhaps some other things lost at our conventions, when all of our apparatus was placed on exhibition; but, as we had no laboratory in Platt's Hall, it was bundled up and relegated to the basement, which was the last I knew of it.

Am safe in saying that during my occupancy of the office, there was no unusual amount of loss, by careless use or stealing, of either books or apparatus.

Trusting this may be satisfactory, and with kind remembrance to yourself and family, in which my own join, I am,

Yours very truly,

JOHN H. WHEELER.

(Unofficial.) San Francisco, January 16, 1896.

Rev. J. H. C. Bonté, *Secretary of the Board of Regents, Berkeley, Cal.:*

Dear Sir: I have your letter of the 13th inst., informing me that certain volumes of the library of the late Board of State Viticultural Commissioners are missing.

After a careful examination of the list submitted, I find that the following ones are the only volumes which ever cost the Board anything, and which have any value, viz.:

No. 148. Etudes sur la Phyl. Vastatrix. Andouin.
No. 146. La Vigne. Bertel.
No. 516. Rudiments of Grape Culture. Eakin.
No. 917. The Phylloxera of the Grapevine. Sousé.
No. 197. Guide du Vigneron. Crolas & Vermorel.

This shows a total loss of five volumes during my administration as custodian of the library during five years, and I doubt if even the University Library can show so small a percentage of loss.

The balance of the volumes mentioned in the list are reports of the United States Government and of the various States, Experimental Stations, etc. Of course, these reports, such as the Report of the Bank Commissioners for 1890, the Reports of Cornell University on Tomatoes, and On the Effect of Green Rations for Cows at Pasture, etc., the reports of the various United States Consuls, etc., can always be had. I believe that I gave away the Report of the Horticultural Commissioners for 1890.

Very truly yours,

WINFIELD SCOTT.

32½ Diamond St., San Francisco, February 16, 1896.

J. H. C. Bonté, Esq.:

Dear Sir: Please pardon the delay in answering your favor of 31st ult., which has arisen from sickness in the family.

As regards the list of missing articles, I know of no one who could give you more information than Clarence J. Wetmore. During the time I was Secretary he had sole charge of all the property, kept all the books of accounts, had charge of the experimental cellar, etc. I think these conditions have been the same for years. Personally, I do not know regarding the things. I have heard C. J. Wetmore say that the microscope was stolen, before I became Secretary. Further than this I know nothing. I am certain the books were not missing during my time; that is, they did not disappear in that period. The cases were kept locked, and if a book was taken out, memo was made of the fact. I can't be sure, though, that these books were all there when I went in. The catalogue was incomplete.

I will be glad to render you any assistance in my power. If it had not been for the sickness referred to, I should have called on you in person.

Yours truly,

CHAS. B. TURRILL.

On August 10, 1896, an inventory of property received from the State Board of Viticultural Commissioners was sent to the Governor of the State; also, list of articles said to have belonged to the Viticultural Commissioners, but which were missing and could not be found; also, copies of letters relative to the missing articles.

Secretary to Turn over to Agricultural Department Property Formerly Belonging to Viticultural Commissioners.—President Kellogg presented communications from Professors Rising and Hilgard respecting certain pieces of property formerly belonging to the Viticultural Commission.

Regent Houghton moved that the Secretary be instructed to turn over to the Agricultural Department all property which Professor Hilgard may deem necessary for the continuation of the work of the Viticultural Commission. [Carried January 14, 1896.]

"*Wine and Spirit Review.*"—Regent Bartlett reported that the Committee on Library and Museum had found, after investigation, that Vol. 31 of the "Wine and Spirit Review" did not belong to the Viticultural Commission when it was turned over to the University, and had returned the volume to its owners, the proprietors of the "Wine and Spirit Review." [Approved February 25, 1896.]

Barn at Chico to be Rebuilt.—Regent Houghton, Chairman of the Committee on Agricultural Experiment Stations, submitted a communication from C. H. Shinn, Inspector of Stations, reporting that the new barn at Chico Forestry Station, which cost $200, was totally destroyed by fire; that a reward of $100 had been offered in the name of the University. It is absolutely necessary to rebuild the barn at once. Large discounts have been secured on bids for lumber and other articles, so that the barn can be duplicated for $125 77 in material and $40 in extra labor.

Your committee recommends the approval of the reward of $100 and of the rebuilding of the barn at a cost not to exceed $175. [Concurred in, on a call of the ayes and noes, July 9, 1895.]

Thanks to Retiring Patrons of Experiment Stations.—In making the usual changes, at the close of the fiscal year, the Board of Regents desire to thank Mr. A. J. Pillsbury of Tulare, Mr. W. H. Kruckeberg of Los Angeles, Mr. J. H. Lee of Chino, and Mr. R. W. Putnam of Paso Robles, for their able and conscientious services as Patrons of their respective Stations. [Adopted June 23, 1896.]

2. Department of Physical Culture.

Resolution Rescinded.—Regent Hallidie submitted the following from the Joint Committee (Finance and Internal Administration):

Your committee recommend that the resolution adopted by the Board, making Physical Culture obligatory for young women, be rescinded. [Concurred in July 23, 1895.]

Director Magee's Request for Vote in Faculty Denied.—Regent Marye submitted the following from the Committee on Internal Administration:

The request of Director Magee to be allowed to vote in Faculty meetings, referred to this committee by the Board, has been considered, and your committee recommends that this request be declined, for the reason that the Organic Act, Section 18, does not include as a voter any one not a Professor. [Concurred in October 8, 1895.]

Segregation of Salaries.—President Kellogg reported the following:

The Physical Culture salaries have seemed to the Internal Administration Committee to be in need of re-adjustment, in view of the new phases of work and the restricted appropriation for that department. A special urgency has arisen in connection with the large classes of young women, necessitating the presence of Mrs. Magee. It is now proposed to divide the $1,200 allotted for salaries, as follows: Dr. Payne and Dr. Ritter, so much for each student examined. This year the numbers are: Dr. Payne, 222; Dr. Ritter, 100; total, 322. At $2 50 for each student, Dr. Payne, $555 for the year, Dr. Ritter, $250 for the year, leaving for Mrs. Magee's instruction of three classes, three hours a week, $395. Dr. Ritter has had measurements as well as examinations, requiring much more time for each student. Dr. Payne will discontinue keeping hours at the Gymnasium, and retain only such hours as he is willing to give for military excuses.

On motion, the segregation of salaries in the Department of Physical Culture, and the appointment of Mrs. Magee, were adopted as recommended. [November 12, 1895.]

Regent Marye, Chairman of the Committee on Internal Administration, submitted the following minute, and recommended its adoption:

The adjustment of the Physical Culture salaries, already considered and approved, apportions to Mrs. Magee $395 from September 1, 1895, to May 15, 1896, or $46 45 per month for eight and one half months, beginning with September 1, 1895, and ending with May 15, 1896. Mrs. Magee's name has never been on the payroll, although she was appointed to this work November 13, 1895, and it is necessary, therefore, to have a call of the ayes and noes on the foregoing. [Adopted, on a call of the ayes and noes, January 14, 1896.]

Deposit of $2 for Medical Examination of Young Women.—President Kellogg submitted the following:

A communication from Director Magee in regard to the examination of young women who apply for instruction in Physical Culture, is presented herewith. I approve the recommendation.

BERKELEY, March 12, 1896.

President KELLOGG:

DEAR SIR: I wish to submit the following for your consideration:

(1) Many women students take advantage of the medical examination provided at the expense of the University as preliminary to the work in this department, and then do not report for the work or attend irregularly, to the great inconvenience of those in charge of the work and disadvantage of the classes.

(2) The work being practically optional, it would be extremely difficult to enforce attendance.

(3) I suggest, therefore, that the amount paid to the examining physician ($2 per student) be deposited by the student with the Secretary of the University, the deposit to be refunded upon the completion of the two years' course, and forfeited if the course be not completed, unless she be excused from further work by the Director.

Respectfully,

WALTER E. MAGEE,
Director of Physical Culture.

On motion, the suggestions contained in the foregoing letter were adopted. [May 13, 1896.]

Deposit of $2 for Medical Examination of Young Men.—President Kellogg submitted the following:

At the meeting of the Board held May 13, 1896, the following minute was adopted relative to young women students attending the Department of Physical Culture, viz.:

> That the amount paid to the examining physician ($2 per student) be deposited by the student with the Secretary of the University, the deposit to be refunded upon the completion of the two years' course, and forfeited if the course be not completed, unless she be excused from further work by the Director.

Mr. Magee now recommends that the same minute be applied to young men. I move that the recommendation be approved. [Concurred in May 20, 1896.]

At the meeting of the Board held September 8, 1896, the above minute was rescinded.

Rent of Gymnasium Lockers.—President Kellogg submitted the following:

I approve a recommendation of Director Magee, in regard to renting lockers in the Gymnasium. It reads as follows: "That it be optional with all students to rent a locker in the Gymnasium at $1 a year, rent to be paid to the Secretary of the University, but the locker to be in charge of the janitor, and to be declared vacant at the end of each college year; also, that the money which is received for locker rent be set aside for the purchasing of new lockers and the urgent repairs of the Gymnasium building." [Adopted May 13, 1896.]

3. Lick Astronomical Department.

Printing Meteorological Observations.—Regent Crocker, on behalf of the Committee on Lick Observatory, submitted the following:

Resolved, That the Secretary of the University be instructed to issue an order on the State Printer for printing an edition of 1,000 copies of an octavo pamphlet entitled "Meteorological Observations at Mount Hamilton from July 1, 1888, to July 1, 1895," prepared by Mr. C. D. Perrine; this pamphlet to be printed and bound uniformly with the Eclipse Reports of the year 1889. [Adopted July 9, 1895.]

Exchange of Land with R. F. Morrow.—Regent Crocker, on behalf of the Committee on Lick Observatory, submitted the following:

Resolved, That the Attorney of this Board confer with Professor Holden and Mr. Morrow, and obtain the proper descriptions of the tracts of land to be exchanged, and prepare deeds for each, to be submitted to this Board for action at its next meeting. [Adopted July 9, 1895.]

Report of Counsel of the Board in re Exchange of Land.—Regent Phelps submitted the following report from J. B. Mhoon, Counsel of the Board:

In re Exchange of Lands with R. F. Morrow.

San Francisco, November 12, 1895.

To the Board of Regents:

I herewith submit a deed from R. F. Morrow, Esq., to the Regents, for about 30 acres of the S.W. ¼ of Sec. 10, T. 7 S., R. 3 E., M. D. M. This deed, as it recites, is pursuant to an agreement between Mr. Morrow and the Lick Trustees, assigned to the Regents.

Also, a deed from Mr. Morrow to the Regents for the balance of the S. ½ of Sec. 10. By the two deeds, the Regents would acquire the S. ½ of Sec. 10. I prepared the two deeds instead of one, because in this way the actual facts are made to appear.

Also, a deed from the Regents to Mr. Morrow for the N. ½ of Sec. 16, same township and range.

I am informed that Mr. Morrow has the certificate of purchase for the S. ½ of Sec. 10, but he has not furnished an abstract of title. I therefore suggest that the exchange be not consummated until the title is examined.

As directed, I have corresponded with Professor Holden about the description of the tracts, and the descriptions set out in the deeds herewith submitted are furnished by him, and I think they are correct.

I will add, by way of suggestion, that Professor Holden thinks the interests of the Observatory will be better served by purchasing Mr. Morrow's land than by the exchange proposed.

Very respectfully,

(Signed:) JOHN B. MHOON.

The following are the forms of deeds:

This Indenture, made the —— day of November, in the year of our Lord one thousand eight hundred and ninety-five, between Robert F. Morrow, the party of the first part, and the Regents of the University of California, the party of the second part,

Witnesseth: That whereas, the party of the first part did, on the 13th day of March, 1886, enter into an agreement with Richard S. Floyd, Charles M. Plum, Edwin B. Mastick, and George Schonewald, as Trustees of the James Lick Trust, whereby the said Robert F. Morrow undertook and promised to convey that piece of land hereinafter described, to the said Trustees, whenever he should have acquired the United States title thereto, in consideration of the sum of one dollar in lawful money of the United States, to be paid by said Trustees to said Morrow; and whereas, said Trustees did thereafter, in writing, and for a valuable consideration, duly assign, set over, and transfer to the said Regents of the University of California, the said agreement above recited; and whereas, the said Morrow has acquired the United States title to said land;

Now, therefore, in consideration of the premises, and in further consideration of the sum of one dollar paid by the said party of the second part to the said party of the first part herein, the receipt whereof is hereby acknowledged, the said party of the first part has granted, bargained and sold, conveyed and confirmed, and by these presents does grant, bargain and sell, convey and confirm, unto the said party of the second part and to its successors and assigns forever, all that certain lot, piece, or parcel of land situated, lying, and being in the County of Santa Clara, State of California, and bounded and particularly described as follows, to wit:

Commencing at the northwest corner of the southwest quarter of section ten (10), in township seven (7) south, of range three (3) east, Mount Diablo base and meridian; thence running east 1,900 feet, more or less, to a six (6) inch post in the center of a sand mound; thence in a southwesterly direction along a post and wire fence 1,500 feet, more or less, to a point in the western boundary of said section ten (10) and distant 1,250 feet, more or less, south from the point of commencement; thence north along said western boundary of said section ten (10), 1,250 feet, more or less, to the point of commencement; being a triangular piece of land containing about thirty (30) acres, and being a portion of the south half of said section ten (10); township seven (7) south, range three (3) east, M. D. M.

Together with all and singular the tenements, hereditaments, and appurtenances thereunto belonging, or in any way appertaining, the reversion and reversions, remainder and remainders, rents, issues, and profits thereof; to have and to hold all and singular the said premises, together with the appurtenances, unto the said party of the second part, and to its assigns and successors forever.

In witness whereof, the said party of the first part has hereunto set his hand and seal, the day and year first above written.

—— —— (Seal).

This Indenture, made this —— day of November, in the year of our Lord one thousand eight hundred and ninety-five, between Robert F. Morrow, the party of the first part, and the Regents of the University of California, the party of the second part,

Witnesseth: That the said party of the first part, for and in consideration of a conveyance of other lands, this day made by the party of the second part to the party of the first part, as evidenced by a deed of even date herewith, executed and delivered by the party of the second part to the party of the first part, the receipt whereof is hereby acknowledged, the party of the first part has granted, bargained and sold, conveyed and confirmed, and by these presents does grant, bargain and sell, convey and confirm, unto the said party of the second part and to its assigns and successors forever, all that certain lot, piece, or parcel of land situate, lying, and being in the County of Santa Clara, State of California, and bounded and particularly described as follows, to wit:

All the south half of section ten (10), in township seven (7) south, range three (3) east, M. D. M., except about thirty (30) acres, more or less, located in a triangular piece in the northwest corner of the southwest quarter of section ten (10), said triangular piece having been heretofore conveyed by said party of the first part to said party of the second part; the lands hereby conveyed containing about 290 acres, more or less.

Together with all and singular the tenements, hereditaments, and appurtenances thereunto belonging, or in any way appertaining, and the reversion and reversions, remainder and remainders, rents, issues, and profits thereof; to have and to hold all and singular the said premises, together with the appurtenances, unto the said party of the second part and to its assigns and successors forever.

In witness whereof, said party of the first part has hereunto set his hand and seal, the day and year first above written.

—— —— (Seal).

This Indenture, made the —— day of November, in the year of our Lord one thousand eight hundred and ninety-five, between the Regents of the University of California, the party of the first part, and Robert F. Morrow, the party of the second part,

Witnesseth: That the said party of the first part, for and in consideration of the conveyance, this day made by the party of the second part to the party of the first part, of certain lands, the receipt whereof is hereby acknowledged, has granted, bargained and sold, conveyed and confirmed, and by these presents does grant, bargain and sell, convey and confirm, unto said party of the second part, and to his heirs and assigns forever, all that certain lot, piece, or parcel of land situate, lying, and being in the County of Santa Clara, State of California, and bounded and particularly described as follows, to wit:

The north half of section sixteen (16), in township seven (7) south, range three (3) east, M. D. M.

Together with all and singular the tenements, hereditaments, and appurtenances thereunto belonging, or in any wise appertaining, and the reversion and reversions, the remainder and remainders, rents, issues, and profits thereof; to have and to hold all and singular the premises, together with the appurtenances, unto the said party of the second part and to his heirs and assigns forever.

In witness whereof, the said party of the first part has hereunto caused its corporate seal to be affixed and these presents to be subscribed by its President and Secretary, the day and year first above written.

—— ——, President.
—— ——, Secretary.

Referred to Regents T. G. Phelps, Charles F. Crocker, and Charles W. Slack, Committee on Lick Observatory, with power to execute the said deeds. [November 12, 1895.]

Donations to Fund for Installing the Crossley Reflector.—Regent Crocker, on behalf of the Committee on Lick Observatory, submitted the following:

Whereas, The following-named friend of the Lick Astronomical Department of the University of California has generously contributed to the fund for installing the Crossley Reflector at Mount Hamilton; namely, T. Ellard Beans, San José, Cal.;

Resolved, That the Regents of the University of California gratefully accept this gift, which will be applied to the purpose named.

Resolved, That the Secretary of the University be instructed to transmit a copy of these resolutions to Mr. Beans. [Adopted July 9, 1895.]

Regent Phelps, Chairman of the Committee on Lick Observatory, submitted the following:

We recommend the adoption of the following resolution:

Whereas, The Glenwood Lumber Company, of San José, has generously contributed to the fund for installing the Crossley Reflector at Mount Hamilton;

Resolved, That the Regents of the University gratefully accept this gift, which will be applied to the purpose named. [Adopted August 13, 1895.]

Regent Phelps offered the following:

Whereas, The following-named friend of the Lick Astronomical Department of the University of California has generously contributed to the fund for installing the Crossley Reflector at Mount Hamilton; namely, the Farmers' Union, San José;

Resolved, That the Regents of the University of California gratefully accept this gift, which will be applied to the purpose named;

Resolved, That the Secretary of the University be instructed to transmit a copy of these resolutions to the Farmers' Union. [Adopted September 10, 1895.]

Regent Slack, on behalf of the Committee on Lick Observatory, submitted the following:

Whereas, The Hon. M. P. O'Connor, of San José, has generously contributed to the fund for installing the Crossley Reflector at Mount Hamilton;

Resolved, That the Regents of the University gratefully accept his gift, which will be applied to the purpose named. [Adopted December 10, 1895.]

Printing 1,200 Copies of Volume of L. O. Publications.—Regent Phelps, Chairman of the Committee on Lick Observatory, reported that about $2,000 had been donated for the purpose of reproducing Professor Barnard's Celestial Photographs, and offered the following resolution:

Resolved, That the Secretary of the University be instructed to issue an order on the State Printer for the printing of an edition of 1,200 copies of a quarto volume of the Publications of the Lick Observatory, said volume to contain Professor Barnard's photographs of Comets, the Milky Way, etc., and the corresponding text. This volume is to be uniform in type, style, and binding with other quarto volumes issued by the Observatory under the direction of the Regents. Of the 1,200 copies of the edition, 900 are for distribution to the regular correspondents of the Observatory, and 300 copies to be transferred to Professor Barnard, to be distributed by him. The expense of illustrating this volume is not to be a charge on the University funds, but is to be met by money now in Professor Barnard's hands. [Adopted September 24, 1895.]

Director Holden's Report to be Printed in Annual Report.—Regent Phelps reported that the Committee on Lick Observatory has had under consideration the annual report of Director Holden. On motion, the report was ordered printed in the Annual Report. [October 8, 1895.]

Professor Barnard Allowed to Use L. O. Negatives.—Regent Phelps moved that Prof. E. E. Barnard be allowed to use Lick Observatory negatives to take photographs of his own work. [Concurred in September 10, 1895.]

Donation to Cover Expenses of Eclipse Expedition to Japan.—Regent Phelps submitted a memorandum of a programme for a Lick Observatory expedition to observe the total eclipse of August, 1896, in Japan, outlining the work to be done, the number of observers, and giving an estimate of the cost.

Regent Phelps stated that Regent Crocker had offered to pay the expenses of the expedition.

Regent Bartlett moved that the eclipse expedition be authorized; that Regent Crocker's offer be accepted, and that the Secretary be instructed to make a suitable acknowledgment to him for his generous offer. [Concurred in, on a call of the ayes and noes, January 14, 1896.]

Eclipse Expedition to Japan.—Regent Crocker, on behalf of the Committee on Lick Observatory, offered the following resolution:

Whereas, A friend of the Lick Observatory has generously offered to bear the expense of an expedition to Japan to observe the total solar eclipse of August, 1896; therefore,

Resolved, That Professor Schaeberle is hereby authorized to proceed, without loss of salary, to Japan, on or about June, 1896, and establish an eclipse station, and to remain there as long as it is necessary for the proper observation of the eclipse;

Resolved, That such expedition shall be entirely without cost to the University of California, and that the safe return of all instruments belonging to the Lick Observatory, which may be used by the expedition, shall be fully insured;

Resolved, That the Director of the Lick Observatory be instructed to prepare general plans and directions for the expedition, and that he be authorized to furnish such instruments as can be spared and as are necessary for use on the expedition. [Adopted February 11, 1896.]

Photo of Mare Crissium.—Regent Crocker submitted a photograph of Mare Crissium, and moved that it be turned over to the President of the University for safe-keeping. [Carried February 11, 1896.]

Removal of Telephone.—Regent Phelps stated that the Mount Hamilton Stage Co. had moved their change station from Hall's Valley to Grand View. They request permission to remove their telephone to Grand View. This will not entail any expense upon the University, and is approved by Director Holden. On motion, permission was granted as requested. [March 31, 1896.]

Permission to Connect Private Telephone with L. O. Wire.—Regent Phelps, Chairman of the Committee on Lick Observatory, submitted a communication from Adam Grant, asking permission to connect a private telephone with the Lick Observatory telephone wire. [Request granted, May 12, 1896.]

4. Department of Military Science and Tactics.

Pay of Armorer.—Regent Miller submitted the following, on behalf of the Finance Committee:

Mr. Sheldon resigned the position of Armorer May 15, 1895. John Mitchell, at the request of Lieutenant Winn, took his place immediately, and has performed the duties of that office ever since and is now performing the same. The salary provided is $30 per month, which has not been paid to Mr. Mitchell. We recommend that $90 be paid to Mr. Mitchell. [Concurred in August 13, 1895.]

Requisition for Additional Rifles and Accouterments.—Regent Hallidie, Chairman of the Finance Committee, submitted the following:

The Professor of Military Science and Tactics requests the Board of Regents to make a requisition for 100 additional rifles and 100 sets of infantry accouterments for the use of the University Battalion.

We recommend that the President of the University be authorized to make requisition for the same on the Ordnance Department of the U. S. Army.

On a call of the ayes and noes, the recommendation was concurred in. [September 10, 1895.]

Bond to the United States for Safe-Keeping of Arms.—Regent Hallidie submitted the following from the Finance Committee:

At the meeting held September 10, 1895, the Board authorized the President of the University to make requisition on the Ordnance Department of the United States Army for additional arms and accouterments.

Your committee submits a bond in the sum of $3,586 for the safe-keeping of said arms and accouterments, which are enumerated below, and recommend that the President and Secretary of the Board of Regents be authorized to sign said bond:

100 Springfield "Cadet" rifles, with appendages, etc., at $15	$1,500 00
100 bayonet scabbards, steel, at 81 cents	81 00
100 waist belts and plates, at 60 cents	60 00
100 cartridge-boxes, caliber 45, at $1 22	122 00
5 arm chests, at $6	30 00
	$1,793 00

[Concurred in November 12, 1895.]

Military Uniforms.—President Kellogg submitted the following:

Referring to accompanying documents, I recommend that the proposal of Lieutenant Winn be adopted, viz.: that the regulations adopted by the Regents May 8, 1894, for the purchase of cadet uniforms, be amended so as to authorize purchases of uniforms to be made in the manner in which other articles are bought at the University. [Adopted May 12, 1896.]

5. Department of Physics.

Donation of Books.—The Secretary submitted the following communication:

To the Secretary of the Board of Regents:

Dear Sir: Having in my possession about one hundred books, relating to physics, which belonged to my late brother, Harold Whiting, I beg to offer them to the University of California, to be placed in charge of the Department of Physics as a department library.

Respectfully yours,

ROSE STANDISH WHITING.

15 Cushman Street, Plymouth, Mass., January 7, 1896.

On motion, the donation was accepted, and the Secretary was instructed to make suitable acknowledgment therefor. [January 14, 1896.]

Donation for Benefit of Department of Physics.—Regent Hallidie submitted the following communication:

Boston, November 4, 1895.

To the Regents of the University of California, Berkeley, Cal.:

Gentlemen: We beg to inform you that the will of Mr. Harold Whiting, now pending for probate in this county, makes a bequest, in the event which we believe to have taken place, of $20,000 to the Regents of the University of California, "for the purpose of using the net income of said fund for the benefit of the Physical Department of said University, requesting, but not directing, said Regents to pay over the net income of said fund to the head of said Department, to be expended by him in his discretion; said fund to be known as the Whiting Fund."

Yours respectfully,

FRANK BREWSTER.
THOMAS J. HORNER.

Referred to the Attorney of the Board, to take necessary steps for the collection of the bequest.

On motion of Regent Rodgers, the President of the University was directed to make suitable acknowledgment. [November 12, 1895.]

The Secretary submitted the following communication from W. H. Payson, attorney-at-law:

San Francisco, December 31, 1895.

J. H. C. Bonté, Esq., *Berkeley, Cal.:*

Dear Sir: Your favor of December 30th is received. Professor Whiting, in his will, bequeathed $20,000 to the University of California. I had a copy of the will, but returned it to Massachusetts for certification. I have forgotten the terms of the bequest, but will send you a copy of it as soon as it is returned to me.

Professor Whiting left very little property in this State. He was a stockholder in the Bald Eagle Mining Co., and held some 8,000 shares of stock. There is also $2,500, an advancement to the company, due to his estate, to be repaid out of the proceeds of the mine.

There were some small deposits in the Pacific Bank, People's Home Savings, and the California National, all of which have gone into liquidation. There was a thousand or eleven hundred dollars in an Oakland bank which was left in trust for certain purposes, and will form no part of the estate. It is quite evident, therefore, that there will not be enough property in this State out of which the bequest could be paid.

Frank Brewster, Esq., 39 Court Street, Boston, Mass., is the executor of the will, and can give you any further information.

Yours respectfully,

W. H. PAYSON.

[On file January 14, 1896.]

6. Department of Civil Engineering and Astronomy.

Donation.—The Secretary submitted the following communication from Assistant Professor Leuschner:

BERKELEY, September 16, 1895.

DR. J. H. C. BONTÉ, *Secretary of the Board of Regents:*

DEAR SIR: Enclosed please find $100, donated to the Department of Civil Engineering and Astronomy by friends of the University, as follows:

Hon. Arthur Rodgers, Nevada Block, S. F. (Ck. No. 1017, 1st Nat'l Bk., S. F.)	$20 00
Hon. Wm. M. Pierson, Mills Bldg., S. F. (Ck. No. 918, 1st Nat'l Bk., S. F.)	20 00
Prof. Louis Lisser, 1241 Franklin St., S. F. (Ck. No. 50, London, Paris, and Amer. Bk.)	10 00
Mr. E. A. Denicke, 321 Sansome St., S. F., cash*	20 00
Hon. Arthur Rodgers, additional	15 00
Hon. Wm. M. Pierson, additional	15 00
	$100 00

Yours respectfully,

ARMIN O. LEUSCHNER.

On motion, the foregoing donations were accepted, and the Secretary was directed to tender the thanks of the Board for the same. [October 8, 1895.]

7. Department of Pedagogy.

Professor Brown, of our Pedagogical Department, has received an invitation to spend two or three weeks during the coming term in giving a course of lectures in a college in Southern California. His absence would be an interruption of his class-work at Berkeley, although arrangements could be made for carrying on a part of that work during those weeks. He does not ask to be released for that purpose. It would be of no pecuniary advantage to him, but he wishes an opinion as to the general policy of such an extension of his work. On the one hand, is the interruption of his University work; on the other, the benefit of helping to organize pedagogical work in a new department of a flourishing college.

The committee appreciate the value of the latter consideration, and see that there is more reason for the transfer of such service in the Pedagogical Department than in any other. This department is charged with a sort of missionary work among the teachers of the State.

But the present proposal is of a much more radical character. It would take a solid block of time from important instruction at the University. It is liable to form an embarrassing precedent in dealing with other institutions. The committee is constrained, therefore, to give an adverse opinion on the proposition presented to them by the Professor of Pedagogy. [Concurred in December 10, 1895.]

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*Check of A. O. Leuschner, Commercial Bank of Berkeley.

8. Library and Art Gallery.

Donation of Portrait of Benjamin P. Avery.—President Kellogg reported that he had received a letter from Mr. Samuel P. Avery, who presents to the Board an oil painting of his brother, Benjamin P. Avery.

On motion, the gift was accepted, and the Committee on Library and Museum was directed to acknowledge the receipt of the picture and tender the thanks of the Board for the same to Mr. Samuel P. Avery. [July 23, 1895.]

Author-Catalogue to be Printed.—Regent Bartlett, Chairman of the Committee on Library and Museum, submitted the following:

The University Library has increased to such an extent (nearly 61,000 volumes) and includes so many rare and valuable books not elsewhere to be found in this State, that we deem it of importance for the convenience and advantage of the citizens of California, as well as of the faculty and students of the University, that a short-title author-catalogue of the same be printed. We therefore request the State Board of Examiners to authorize the printing of the same, in an edition of nine hundred and fifty copies, at the State Printing Office. [Adopted August 13, 1895.]

Donation of Municipal Reports.—Regent Bartlett, Chairman of the Committee on Library and Museum, submitted the following:

Mr. Wm. Alvord has presented to the Library a complete set (34 volumes) of municipal reports. Your committee recommends that the gift be accepted, and that the Secretary be instructed to tender the thanks of the Board for the same. [Approved August 13, 1895.]

Donation of Pamphlets Relating to Industrial Education.—The Secretary reported the receipt of six pamphlets, relating to Industrial Education, from Mr. Antoine Borel, Swiss Consul. [September 10, 1895.]

Reese Fund Apportionment.—Regent Bartlett submitted the report of the Committee on Library and Museum, as follows:

The Committee on Library and Museum respectfully submits the following recommendations as to the apportionment of the Reese Fund among the various departments of instruction for the purchase of books for the Library, to wit:

Agriculture, Viticulture, Entomology—Hilgard	$100 00
Astronomy, Civil Engineering—Soulé	100 00
Botany—Setchell	225 00
Drawing—Kower	50 00
Education—Brown	125 00
English—Gayley	200 00
Chemistry—Rising	100 00
French—Paget	100 00
German—Putzker	100 00
Greek—Clapp	100 00

Latin—Merrill	$100 00
Geology, Zoölogy, Palæontology, Mineralogy—Le Conte	125 00
History, Politics, Economics—Moses	200 00
Mechanics—Hesse	100 00
Mathematics—Stringham	100 00
Mining, Metallurgy—Christy	75 00
Military Science—Winn	25 00
Philosophy—Howison	100 00
Physics—Slate	100 00
Art—Ardley	150 00
Jurisprudence—Jones	100 00
Astronomy—Leuschner	50 00
General Works—Librarian	119 29
	$2,544 29

[Approved November 12, 1895.]

Donation for Lighting the University Library.—Regent Houghton submitted the following communication:

San Francisco, January 13, 1896.

To the Honorable the Regents of the University of California:

Dear Sirs: We have been informed by Regent Reinstein that the Library of the University of California has always been closed at night because of lack of funds for the lighting of the building. Desiring to increase the advantages offered by the Library through having it open during the evening, we beg to subscribe for that purpose, each, the sum of $250, making $1,000, which we are told is sufficient to have the building lit by electric light.

LEVI STRAUSS.
LOUIS SLOSS, per L. S., Jr.
J. L. FLOOD.
G. W. McNEAR.

On motion, the foregoing donations were accepted, and the Secretary was instructed to make suitable acknowledgment. [January 14, 1896.]

Donation of Books by Californian Authors.—Regent Bartlett, Chairman of the Committee on Library and Museum, submitted the following:

Mr. Samuel P. Avery, of New York, has presented the University Library with a collection of fifteen books by Californian authors. Your committee recommends that the gift be accepted, and that the Secretary be instructed to make suitable acknowledgment of the gift. [Concurred in January 14, 1896.]

Donation of Portrait of Rev. Horatio Stebbins.—Regent Hallidie presented the following communication:

San Francisco, Cal., March 3, 1896.

Honorable Board of Regents, University of California:

Gentlemen: A number of friends of ex-Regent Rev. Horatio Stebbins, D.D., have caused the portrait of that distinguished man, so many years a Regent of the University of California, to be painted by an artist of acknowledged ability, Mr. T. M. Vermocken, for the purpose of presenting the same to the State University, of which your honorable body is the governing board.

The portrait being now completed, we take pleasure in submitting the same for your acceptance, and will be pleased if you will appoint a day and place when and where the portrait shall be formally presented.

We have the honor to be, very truly, etc.,

J. PERRY, Jr.
C. F. CROCKER.
COLUMBUS BARTLETT.
JOHN B. MHOON.
WM. T. WALLACE.
CHAS. W. SLACK.
HENRY J. CROCKER.
ARTHUR RODGERS.

I. W. HELLMAN.
JAS. D. PHELAN.
G. H. HOWISON.
JOSEPH LE CONTE.
MARTIN KELLOGG.
A. S. HALLIDIE.
E. W. HILGARD.
GEO. T. MARYE, Jr.
J. F. HOUGHTON.

Regent Hallidie then offered the following:

The President of the University is authorized and requested to nominate three members each of the Board of Regents and the Academic Senate, who, together with himself, shall constitute a committee to meet a committee of the subscribers to the Horatio Stebbins Portrait Fund, and on behalf of the Board of Regents to formally accept the portrait of ex-Regent Horatio Stebbins, and to provide for the placing of said portrait in a suitable position in the Library building at Berkeley. [Adopted March 10, 1896.]

Donation of Books and Pamphlets on Quicksilver.—Regent Slack offered the following resolution:

Resolved, That the thanks of the Board be tendered to J. B. Randol, Esq., for his generous gift to the Library of the University of his collection of books and pamphlets on quicksilver and quicksilver-mining; and that the Secretary of the Board send a copy of this resolution to Mr. Randol. [Adopted April 7, 1896.]

Donation of Set of "Challenger Reports."—President Kellogg reported as follows:

A valuable donation to the Library has been made by the British Government, viz., a set of the "Challenger Reports." Secretary Olney transmits a communication from the Hon. T. F. Bayard, at whose suggestion five copies of these very valuable reports have been sent to as many American institutions, our own University being one of the five. The books are expected to arrive soon.

On motion, it was ordered that the receipt of the gift be acknowledged, with the thanks of the Board. [April 14, 1896.]

Donation of Law Books for Department of Jurisprudence.--President Kellogg reported the following:

A valuable gift of books has been made to the University for the especial use of the Department of Jurisprudence. It is described in the following excerpt:

San Francisco, May 1, 1896.

Professor Wm. Carey Jones, *University of California:*

Dear Professor: I have the pleasure of informing you of the shipment of 403 volumes of law reports and digests to the Library of the University, for the use, primarily, of the Department of Jurisprudence. The Bancroft-Whitney Co. has generously donated $899 of the price of the books, and the balance of the price, amounting to $400, has been contributed by the following graduates of the University: William G. Brittan, George D. Boyd, Wm. R. Daingerfield, E. S. Heller, Jerome B. Lincoln, Alexander F. Morrison, Arthur Rodgers, Charles W. Slack, and Charles S. Wheeler.

Very truly yours,

CHARLES W. SLACK.

Regent Hallidie moved that the gift be accepted, and that the thanks of the Board be tendered to the several persons named. [May 12, 1896.]

Privileges of Library Extended to Columbus Bartlett.—Regent Reinstein, on behalf of the Committee on Library and Museum, offered the following resolution:

Whereas, Hon. Columbus Bartlett rendered faithful and discriminating service to the University as a Regent, and especially as a member of the Committee on Library and Museum; therefore, as a slight recognition of such service,

Resolved, That all the privileges of the University Library and

Museum are extended to Mr. Bartlett for the future. [Adopted May 13, 1896.]

Periodicals Ordered Purchased.—Regent Bartlett, Chairman of the Committee on Library and Museum, submitted the following:

Your committee recommend the purchase of the following periodicals for the year 1896:

Analyst	$2 56
Electrical World	2 60
Journal of Geology, Vol. 1	2 55
Quarterly Journal of Micros. Science	9 00
Astronomische Nachrichten	8 50
Popular Astronomy, Vols. 1–2	4 40
Amer. Eng. & R. R. Journal	2 40
	$32 01

On motion, it was ordered that the sum of $32 01 be transferred from the appropriation for the purchase of books from the General Fund, for the purchase of above-named periodicals. [January 14, 1896.]

9. Museum.

Management of the Museum.—President Kellogg submitted the following:

At a meeting of the Board, held July 9, 1895, a minute was adopted regarding the care of the Museum for the ensuing year. After further consultation with Professor Le Conte and others in the Department of Natural Sciences, I propose the following modification of the action then taken:

The University Museum shall be temporarily under the control of Professor Le Conte, head of the Department of Natural Sciences, who will assign the care of the several sections of the Museum to his assistants in that department.

It is understood that Assistant Professor Johnson, already appointed for half work in the Museum, will receive directions from Professor Le Conte. Also, that he will provide for certain hours in which the rooms shall be open to the students and the public. [Approved August 13, 1895.]

10. Appointments.

1895—July 9	Edgar L. Hinman	Fellow in Philosophy.
July 9	James Gillick	Assistant in the Printing Office.
July 9	E. P. Lewis	Instructor in Physics.
July 9	A. C. Alexander	Assistant in Physics.
July 9	Arthur Incell	Assistant in Physics.
July 9	Arthur L. Jordan	Student Assistant in the Department of Physics.
July 9	C. W. Leach	Instructor in History.
July 9	Clive Day	Instructor in History.
July 9	Eugene Pitcher	Assistant in Latin.
July 9	Clifton Price	Instructor in Latin.
July 9	H. P. Johnson	Assistant in the Museum.
July 9	W. H. Wright	Fellow in Mathematics.
July 9	A. V. Saph	Fellow in Mathematics.
July 9	F. H. Seares	Assistant in Students' Observatory.
July 9	Ira Currier	Machinist and Fireman in the Mechanical Department.
July 9	William J. Hussey	Astronomer in the Lick Observatory.
July 9	R. G. Aitken	Assistant Astronomer in the Lick Observatory.
July 23	H. B. Torrey	Assistant in Biology.
July 23	R. J. de Lapierre	Assistant in French.
July 23	W. W. Fogg	Assistant in Field Practice.

1895—July 23—A. E. Chandler ... Student Assistant in Civil Engineering.
Aug. 13—W. L. Jepson ... Instructor in Botany.
Aug. 13—John H. Gray, Jr. ... Assistant in Chemistry.
Aug. 13—H. H. Hirst ... Student Assistant in Field Practice.
Sept. 10—John Fryer ... Professor of Oriental Languages and Literature.
Sept. 10—W. A. Setchell ... Professor of Botany.
Sept. 10—R. Sherman ... Clerk to the Recorder.
Sept. 10—F. H. Seares ... Fellow in Astronomy.
Sept. 10—F. E. Ross ... Assistant in Astronomy.
Sept. 10—Walter H. Graves ... Reader in the Latin Department.
Sept. 10—S. A. Moss. Student Assistant in the College of Mechanical Engineering.
Sept. 10—Volney H. Craig ... Janitor of the Library Building.
Sept. 10—Frank H. Dunn ... Fellow in Pedagogy.
Sept. 10—F. G. Cottrell. Honorary Student Assistant to the Professor of Chemistry.
Sept. 10—George D. Louderback ... Honorary Student Assistant to the Professor of Chemistry.
Sept. 10—J. H. Mitchell ... Armorer.
Oct. 8—Richard Weiler ... Assistant in German.
Oct. 8—Dr. Thomas Maclay ... Professor of the Principles and Practice of Veterinary Surgery, Pathology, and Bacteriology.
Oct. 8—Dr. K. O. Stiers ... Professor of the Principles and Practice of Equine Medicine and Dermatology.
Nov. 12—James T. Allen ... Reader in Greek.
Nov. 12—F. L. Ransome ... Honorary Fellow in Mineralogy.
Nov. 12—Charles A. Von Hoffman ... Associate Professor of Gynecology in the Medical Department.
Nov. 12—Mrs. W. E. Magee ... Assistant in Physical Culture.
Dec. 10—John H. Barber ... Foreman of Santa Monica Forestry Station.
Dec. 10—J. Burtt Davy ... Assistant in Botany.
1896—Feb. 11—J. C. Rockwell ... Assistant Professor *ad interim* of Classical Archæology.
Mar. 10—W. H. Rees ... Honorary Assistant in Chemistry.
Mar. 10—A. V. Stubenrauch ... Foreman of Paso Robles Experiment Station.
Mar. 10—William Winterhalter ... Clerk to the Director of Agricultural Experiment Stations.
Mar. 10—W. H. Lozier ... Fireman in the College of Mechanics.
Apr. 14—W. B. Lewitt, M.D. ... Associate Professor of Diseases of Children in the Medical Department.
Apr. 14—W. H. Rees ... Assistant in Chemistry.
Apr. 14—Francis Dunn ... Honorary Fellow in Argumentation.
Apr. 28—H. A. Overstreet ... Clerk to the Recorder of the Faculties.
May 13—Myer E. Jaffa, B.S. ... Assistant Professor of Agriculture.
May 13—Exum P. Lewis, Ph.D. ... Assistant Professor of Physics.
May 13—William J. Raymond, B.S. ... Assistant Professor of Physics.
May 13—Louis Du Pont Syle, A.M. ... Assistant Professor of English Literature.
May 13—T. F. Sanford ... Instructor in English.
May 13—W. M Hart ... Instructor in English.
May 13—W. L. Jepson ... Instructor in Botany.
May 13—J. C. Merriam ... Instructor in Palæontology.
May 13—E. B. McGilvary ... Instructor in Logic.
May 13—J. H. Gray, Jr. ... Instructor in Chemistry.
May 13—Arthur Incell ... Assistant in Physics.
May 13—J. Burtt Davy ... Assistant in Botany.
May 13—F. Richards ... Helper in Metallurgical Laboratory.
May 13—H. B. Torrey ... Assistant in Biology.
May 13—Francis Dunn ... Fellow in Pedagogy.
May 13—W. S. T. Smith ... Fellow in Mineralogy.
May 13—A. L. Jordan ... Student Assistant in Physics.
May 13—G. F. Reinhardt ... Student Assistant in Physical Culture.
May 13—K. C. Babcock, Ph.D. ... Instructor in History and Political Science.
May 13—W. J. V. Osterhout, A.M. ... Instructor in Botany.
May 20—George M. Stratton ... Instructor in Psychology.
May 20—C. Price ... Instructor in Latin.
May 20—E. Pitcher ... Assistant and Reader in Latin.
May 20—Dr. R. Weiler ... Assistant in German.
May 20—H. Ongerth ... Reader in German.
May 20—H. P. Johnson ... Assistant Professor in Biology.
May 20—A. C. Alexander ... Assistant in Physics.
May 20—Charles P. Nott ... Assistant in Botany.
May 20—W. J. Sharwood ... Instructor in Chemistry.
May 20—W. C. Blasdale ... Instructor in Chemistry.
May 20—Charles Gilman ... Assistant in Chemistry.
May 20—R. R. Rodgers ... Assistant in Chemistry.
May 20—L. E. Hunt ... Instructor in Civil Engineering.
May 20—H. H. Hirst ... Assistant in Civil Engineering.
May 20—B. R. Maybeck ... Instructor in Drawing.
May 20—O. Schober ... Assistant in Mechanics.

1896—May 20—A. Hersam .... Instructor in Metallurgy, and Analytical Assistant.
May 20—E. H. Simonds .... Instructor in Assaying, and Mill Assistant.
May 20—Mrs. G. E. Magee .... Assistant in Physical Culture.
May 20—L. F. Chesebrough .... Instructor in Mechanics, and in Charge of Machine Shops.
May 20—F. H. Seares .... Instructor in Astronomy.
May 20—F. E. Ross .... Fellow in Astronomy.
May 20—J. H. Mitchell .... Armorer.
May 20—Clive Day .... Instructor in History.
June 23—John Calvert, Ph.G. ..Professor of the Theory and Practice of Pharmacy.
June 23—S. D. Ayers .... Patron of Southern Coast Range Experiment Station.
June 23—Rev. C. F. Loop .... Patron of Southern California Experiment Station.
June 23—Roy Jones .... Patron of Santa Monica Forestry Station.
June 23—John Twohy .... Patron of San Joaquin Experiment Station.
June 23—R. C. Rust .... Patron of Amador Experiment Station.
June 23—Robert Pennell .... Patron of Chico Forestry Station.
June 23—F. Boegle, Jr. .... Stenographer and Typewriter in President's and Recorder's Offices.

Changes of Titles.—President Kellogg submitted the following:

The title of H. P. Johnson, which last year was that of "Assistant Professor of Biology," should remain the same while he is in charge of the Museum.

On motion, H. P. Johnson's title as Assistant Professor of Biology was continued. [October 8, 1895.]

MOUNT HAMILTON, December 2, 1895.

HON. T. G. PHELPS, *Chairman L. O. Committee:*

MY DEAR SIR: It is known to your committee that Mr. Perrine, the Secretary of the Observatory, has taken part in our astronomical work in addition to performing the clerical work of his office. This is entirely voluntary on his part and is extra work. He has made daily photographs of the sun and of sun-spots since August, 1893, and has secured about 1,500 negatives. He has also taken part in the photographic work with the large telescope, in observations of meteors, etc., and has made systematic search for comets. On November 17th, he discovered an unexpected comet, which is now under observation here. Besides this work of observation, he is pursuing a course of study in theoretical astronomy. His present title does not correctly describe his position in the Observatory. I therefore respectfully recommend that his title be changed from Secretary, to that of Secretary and Assistant Astronomer, of the Lick Observatory, such change of title to involve no change in his present salary.

All his colleagues in the Observatory feel that such a recognition of his work here has been fully earned, and it is a pleasure to me personally to submit the foregoing recommendation.

I am, my dear sir,
Very respectfully and truly yours,
EDWARD S. HOLDEN.

In accordance with the recommendation contained in Director Holden's letter the following resolution was submitted by the Committee on Lick Observatory:

Resolved, That C. D. Perrine's title of Secretary of the Lick Observatory be changed to that of Secretary and Assistant Astronomer, such change of title to involve no change in his present salary. [Adopted December 10, 1895.]

Regent Hallidie, Chairman of the Committee on Finance and Audit, submitted the following:

Your committee recommends that the under-mentioned employés of the University, connected with the Johnson Building, be placed on the regular monthly salary roll of the University:

Benjamin Bangs, agent	$100 per month.
J. C. Layton, engineer	85 per month.
John Kusel, janitor	75 per month.
R. H. Jones, elevator boy	30 per month.
Gus Leveque, freight elevator boy	26 per month.
	$316 per month.

[Concurred in February 11, 1896.]

11. Phebe Hearst Scholarships.

President Kellogg submitted the following:

Professor Wm. Carey Jones sends in the following communication concerning the Hearst Scholarships:

Berkeley, July 5, 1895.

President Kellogg:

Dear Sir: The following are the data relative to the awarding of the Phebe Hearst Scholarships, which I presume you will wish to report to the Board of Regents:

The Academic Council at a meeting held May 13, 1895, voted that the Committee on Scholarships of the Academic Council be given power to make awards of the Phebe Hearst Scholarships for the academic year 1895–96.

The committee were in receipt of nearly sixty applications from young women for appointment as Phebe Hearst Scholars. In view of the great number of meritorious applicants, the committee directed their Chairman to write to Mrs. Hearst, asking authority to reduce the annual value of each scholarship from $300 to $200, and to make a corresponding increase in the number of scholarships, namely, from eight to twelve.

Mrs. Hearst responded as follows, in a letter dated London, June 9, 1895:

"I am not willing to decrease the amount of the scholarships, for I feel that three hundred dollars is quite little enough to pay a girl's living expenses, pay for books, etc. The idea was to give it to those who could not possibly go to the University without this fund, and if we were to make it necessary for them to secure a part of the amount, we might be debarring some of the most deserving.

"I am willing to pay the same amount monthly for four more young ladies for the number of years that their course will last, but as I have other things which I wish to do in California, I cannot make this additional sum a permanent fund. The first eight scholarships are, of course, secured in perpetuity, but the additional four will only last while the young ladies holding them are finishing their course."

The committee, by authority of the Academic Council, and in accordance with the above expressed wishes of Mrs. Hearst, have appointed the following persons as Phebe Hearst Scholars for the academic year 1895–96:

Permanent Scholarships Reappointed.

Lucy Ware Williams	National City.
Jessie Mabel Anderson	San Francisco.
Amanda Krenz	Napa.
Stella Price	Santa Ana.
Eleanor Vanderbilt Bennett	Oakland.
Edith Florence Culin	Los Angeles.
Katherine Lynch	Lynch, San Luis Obispo County.
Newly appointed:	
Stella Young	Los Angeles.

Temporary Scholarships.

Jacqueline K. Newton	Nordhoff.
Jessie Walrath Dewell	Fresno.
Anna Maria Landstrom	Berkeley.
Thirmuthis A. Brookman	Los Angeles.

Respectfully,

WM. CAREY JONES,
Chairman of Committee on Scholarships.

[Approved July 9, 1895.]

President Kellogg stated that Lucy W. Williams, one of the Hearst Scholars, whose appointment was confirmed at the meeting of the Board held July 9, 1895, had been granted a leave of absence by the Academic Council, and that by authority of the Council the committee had selected Miss Ida A. Knall as Scholar for year 1895–96. [Approved September 10, 1895.]

President Kellogg submitted the following:

The vote accepting Miss Knall as a Phebe Hearst Scholar for the current year should, I think, be modified so as to give her the whole amount of the Scholarship for the year 1895–96, viz., $300.

Regent Bartlett moved that Miss Knall be paid the whole amount of the Scholarship, $300, for the year 1895–96. [Carried October 8, 1895.]

Phebe Hearst Scholarships for 1896–97.—Reappointed as holders of the four temporary Phebe Hearst Scholarships for 1896–97:

Jacqueline K. Newton	Nordhoff.
Jessie W. Dewell	Fresno.
Anna M. Landstrom	Berkeley.
Thirmuthis A. Brookman	Los Angeles.

Reappointed as holders of Phebe Hearst Scholarships for 1896–97:

Amanda Krenz	Napa.
Stella Price	Santa Ana.
Katherine Lynch	Lynch.
Stella E. Young	Los Angeles.
Ida Amelia Knall	Oakland.

Reappointed, after a leave of absence of one year, to be Phebe Hearst Scholar for 1896–97, to fill a vacancy:

Lucy Ware Williams	National City.

Appointed to fill vacancies in the list of Phebe Hearst Scholarships for 1896–97:

Laura Frank	San Francisco.
Edna Robinson	San Luis Obispo.

Phebe Hearst Scholar for the second half-year of the year 1896–97, January to May, inclusive, in place of Miss Krenz, who is expected to finish her course at the end of the first half-year:

Lily Hohfeld	San Francisco.

12. RESIGNATIONS.

1. Resignation of R. S. Norris, Assistant in Chemistry. [Accepted August 13, 1895.]

2. Resignation of W. H. Tyson, Foreman of the South Coast Range Station, to take effect November 1, 1895.

3. Resignation of Prof. Thomas Bowhill, of the Veterinary Department. [Accepted October 8, 1895.]

4. Prof. A. E. Buzard, of the Veterinary Department. [Accepted October 8, 1895.]

5. W. J. Strachan, Foreman of Santa Monica Forestry Station. [Accepted December 10, 1895.]

6. Resignation of Ivar Tidestrom, Assistant in the Department of Botany. [Accepted January 14, 1896.]

7. Resignation of Dr. H. M. Sherman, Professor of Orthopedic Surgery in the Post-Graduate Medical Department of the University. [Accepted February 11, 1896.]

8. Resignation of Dr. W. F. McNutt, as Professor of Diseases of the Heart and Kidneys in the Post-Graduate Medical Department, San Francisco Polyclinic. [Accepted March 10, 1896.]

9. Resignation of M. A. Howe, Instructor in Cryptogamic Botany. [Accepted April 28, 1896.]

10. R. H. Sherman, Clerk to the Recorder of the Faculties. [Accepted April 28, 1896.]

11. Resignation of W. H. Wright, Fellow in Mathematics. [Accepted June 9, 1896.]

12. C. A. Seifert, Professor of the Theory and Practice of Pharmacy. [Accepted June 23, 1896.]

13. Josephine E. Barbat, Instructor of Botany in the College of Pharmacy. [Accepted June 23, 1896.]

14. Grace Love, Stenographer and Typewriter in President's and Recorder's offices. [Accepted June 23, 1896.]

13. LEAVE OF ABSENCE.

Dr. E. S. Holden, for one month, without loss of pay. [November 12, 1895.]

Associate Professor G. M. Richardson, for one year, with a monthly allowance of $50 during the year. [December 10, 1895.]

A. B. Pierce, Instructor in Mathematics, from May 1 to October 1, 1896, without loss of pay. [February 11, 1896.]

Professor J. M. Schaeberle, Astronomer at the Lick Observatory, from January 1 to March 1, 1896, without loss of pay. [February 11, 1896.]

H. P. Johnson, Assistant Professor of Biology, from February 4 to March 15, 1896. [February 11, 1896.]

W. H. Wright, Fellow in Mathematics, from April 1 to June 30, 1896. [March 10, 1896.]

Associate Professor G. M. Richardson, from April 27 to June 30, 1896. [March 10, 1896.]

G. M. Stratton, Instructor in Philosophy, leave extended from August 15 to September 15, 1896. [March 10, 1896.]

T. F. Sanford, Instructor in English, from May 5th to end of the term. [April 14, 1896.]

A. O. Leuschner, Assistant Professor of Astronomy and Geodesy, for one year on half pay. [April 14, 1896.]

W. M. Hart, Instructor in English, from close of examinations. [April 28, 1896.]

Professor Joseph Le Conte, from August 10, 1896, to January 10, 1897, without loss of pay. [May 12, 1896.]

W. L. Jepson, Instructor in Botany, from August, 1896, to January, 1897. [May 13, 1896.]

Dr. E. S. Holden, for two months, without loss of pay. [May 19, 1896.]

President Kellogg submitted the following:

Instructor Price has been obliged by ill health to leave his work in another's hands for a few weeks: the arrangement for carrying it on having the full approval of Professor Merrill.

Approved, without loss of pay to Mr. Price and without extra expense to the University. [December 10, 1895.]

Regent Hellman requested leave of absence for six months on account of ill health. [Granted March 31, 1896.]

President Kellogg requested that he be excused from attendance at the July meeting of the Board, and that during his absence from the University the Dean be authorized to sign such papers as require the President's signature. [Approved June 23, 1896.]

14. Appropriation for Summer Schools in Chemistry and Physics.

President Kellogg reported as follows:

The Summer Schools in Chemistry and Physics have proved very important for the teachers of the State. Heretofore they have been voluntarily conducted by members of these departments without compensation. This year there is danger that these schools will fall through, as the Professors in charge are unwilling to impose the extra labor on their subordinates without recognition of their services.

I recommend that a small sum, say $150, be set aside for each of these two schools, to be used at the discretion of the heads of these two departments, to be taken from next years' budget for such schools. [Concurred in, on a call of the ayes and noes, April 14, 1896.]

15. Relating to Salaries.

	From—	To—
July 9—E. R. Drew, Instructor in Physics	$1,200	$1,500
July 9—R. H. Tucker, Astronomer at Lick Observatory	1,800	2,000
July 9—C. D. Perrine, Secretary of Lick Observatory	1,200	1,320
July 9—Paul Soto, Laborer at Lick Observatory	300	360
July 23—L. E. Hunt, Assistant in Civil Engineering	840	960
July 23—W. W. Fogg, Assistant in Field Practice	600	840
Sept. 10—H. B. Torrey, Assistant in Biology	300	450
Nov. 12—W. L. Jepson, Instructor in Botany	900	1,100

President Kellogg reported the following:

Mr. W. J. Hollinger, who was killed last Saturday while working for the University, has been for years a faithful employé of the University. He leaves a widow, with four young children. I suggest that his wages be continued for the benefit of his family to the end of this month. [Concurred in July 9, 1895.]

President Kellogg reported the following:

I have presented to the Committee on Internal Administration a proposal to equalize certain salaries more nearly, in the three Engineering Colleges.

E. A. Hersam to be reduced from $1,500 to $1,350 per annum.

E. H. Simonds to be reduced from $1,200 to $1,000 per annum.

Oscar Schober to be reduced from $1,200 to $1,000 per annum.

L. E. Hunt to be increased from $840 to $960 per annum.

W. W. Fogg to be increased from $600 to $840 per annum.

A. E. Chandler, $200 per annum.

On a call of the ayes and noes, the foregoing changes in the salaries were approved. [July 23, 1895.]

Regent Miller, on behalf of the Finance Committee, recommended that S. J. Holmes' claim for salary as Assistant in Biology for the month of July and half of August be denied. [Concurred in September 24, 1895.]

Regent Miller submitted the following on behalf of the Finance Committee:

Richard Weiler, Assistant in German, began his work in the German Department September 1, 1895. September 24, 1895, his pay was fixed at $25 per month, but as no reference was made to the date of his appointment, it took effect September 24, 1895. Your Finance Committee recommends that Mr. Weiler's appointment be dated as of September 1, 1895, and that he be paid his full salary from that date. [Concurred in, on a call of the ayes and noes, October 8, 1895.]

Regent Miller, on behalf of the Finance Committee, submitted the following:

September 10, 1895, this Board increased the salary of H. B. Torrey from $300 to $450 for the year. There being no date mentioned, the increase began on the date of the Board meeting. The intention was that the salary begin on August 13, 1895. Your committee recommend that Mr. Torrey's salary be made to date from August 13, 1895, and continue for the year. [Concurred in, on a call of the ayes and noes, October 8, 1895.]

Regent Hallidie, Chairman of the Committee on Finance and Audit, reported as follows:

At the meeting of the Board held October 8th, it was ordered that Mr. H. B. Torrey's pay, at the rate of $37 50 per month, be counted from August 13th. Your committee now recommends that Mr. Torrey's pay begin from July 1, 1895, at $37 50 per month. [Concurred in, on a call of the ayes and noes, November 12, 1895.]

President Kellogg submitted the following:

A small temporary re-adjustment is requested by Professor Setchell. It is explained in the minute from the Finance Committee.

Ivar Tidestrom, Assistant in Botany, who resigned December 31, 1895, had a salary of $50 per month. Professor Setchell cannot at once supply his place. He is having the same work done by the hour, and asks the sanction of the Board for an expenditure of $50 per month till a permanent employé can be found. To date from January 1, 1896.

On motion, Professor Setchell's request was granted. [February 11, 1896.]

16. Land Matters.

Sale of Land in El Dorado County.—Regent Slack submitted the report of the Land Committee, as follows:

Your Committee on Congressional Land Grant is in receipt of a communication from the Carson and Tahoe Lumber and Fluming Company, of Carson, Nevada, offering to purchase, at $5 per acre, 1,040 acres of land held by the University in El Dorado County, being the S.E. ¼ of Sec. 13; S. ½, N.E. ¼, E. ½ of N.W. ¼, of Sec. 24; the S.E. ¼, E. ½, of N.E. ¼, the W. ½ of the N.W. ¼, of Sec. 25, all in Tp. 12 N., range 17 E., including 1,040 acres of land.

Your committee is of the opinion that this offer should be accepted, and recommend that a proper deed therefor be delivered when said land is paid for by the Carson and Tahoe Lumber and Fluming Company. [Concurred in December 10, 1895.]

Governor Requested to Issue Patent for Land in El Dorado County.—Regent Rodgers offered the following resolution:

Resolved, That the Land Agent of the University of California make his certificate showing that the Treasurer of the University of California has received the sum of $5,200 from the Carson and Tahoe Lumber and Fluming Company, in full payment for 1,040 acres of land in El Dorado County, described as follows: The S.E. ¼ of Sec. 13; S. ½, N.E. ¼, E. ½ of

N.W. ¼, of Sec. 24; S.E. ¼, E. ½ of N.E. ¼, W. ½ of N.W. ¼, of Sec. 25, all in Tp. 12 N., R. 17 E., M. D. M., and further showing that said land has been listed to the State of California by the United States as a portion of the 150,000 acres granted to the State, and that said company is entitled to a patent therefor; and further request the Governor to issue the same to said company. [Adopted February 20, 1896.]

Prof. E. E. Brown to Represent the University of California at the meeting of Land Grant Colleges.—President Kellogg reported as follows:

It is highly desirable that the University be represented at a meeting of the Land Grant Colleges, to be held this summer in connection with the general meeting of the National Educational Association. If the Finance Committee do not object, I nominate Prof. Elmer E. Brown to be our representative at that meeting, with railroad fare prepaid.

On a call of the ayes and noes, the matter was referred to the Finance Committee, with power to act. [June 23, 1896.]

[June 24, 1896, the Finance Committee approved the recommendation.]

President Kellogg moved that Regent Black be also an accredited representative of the Board of Regents at the meeting of the Land Grant Colleges. [Concurred in June 23, 1896.]

17. Loans.

Regent Hallidie, Chairman of the Finance Committee, submitted the following:

In relation to Wm. C. Turner's mortgage, your committee recommends that the Counsel of the Board be instructed to file a complaint for foreclosure and get service and appearance against the administrator, and then permit the mortgage to stand until he receives further instructions from the Finance Committee. [Concurred in July 9, 1895.]

Regent Hallidie, Chairman of the Finance Committee, submitted the following:

The mortgage of $6,000 held by the Regents from E. Hook, on certain property in Oakland, has been renewed by Fannie McAllis, in whom title to the lands mortgaged now rests. The mortgage was renewed from July 29, 1895, for five years, at 7% per annum. One thousand dollars has been received by the Treasurer on account of the principal of this mortgage. [Approved November 12, 1895.]

Regent Hallidie, Chairman of the Finance Committee, reported the following:

Your committee reports that Mr. J. A. Hardin's mortgage of $20,000 has been renewed for two years at 7% per annum, interest payable semi-annually, dating from June 26, 1895. Mr. Hardin has paid $2,000 on account of said note, and has promised to pay $2,000 more in thirty days. [Approved November 12, 1895.]

Regent Hallidie submitted the application of Mrs. Mary Jane Daniels for a loan of $26,000 for two years at 6% per annum, on the following described property: Undivided half in N.W. cor. East and Clay streets, 142 feet front on S.W. line East Street to S.W. cor. East and Merchant streets; thence west along S. line Merchant Street 35 feet front; thence south 115 feet to north line Clay Street; thence at right angles easterly along north line Clay Street 117½ feet to point of beginning, covered by old two-story frames. Insurance, $10,000.

On a call of the ayes and noes, the Board ordered that the application be granted, and that the Finance Committee be authorized to draw on the Treasurer of the University for the said sum of $26,000, upon receiving a certificate from J. B. Mhoon, Counsel of the Board of Regents, to the effect that the title is in Mrs. M. J. Daniels. [March 31, 1896.]

Regent Hallidie reported that at the last meeting of the Board the Finance Committee was authorized to make a loan of $26,000 to Mrs. M. J. Daniels. Since then the attorney of the Board has looked more thoroughly into the matter and the Finance Committee have thought it to the best interests of the Regents not to consummate the loan. [Approved April 14, 1896.]

Regent Hallidie, Chairman of the Finance Committee, submitted the following:

Your committee submits herewith the application of James B. Lankershim for a loan of $50,000 for three years at 7% per annum on property on the southeast corner of Spring and Third streets, Los Angeles. The lot is 60 feet by 90 feet, and there is being erected on it a five-story-and-basement iron, stone, and brick building, to cost from $60,000 to $75,000. Your committee is of the opinion that the security is ample, and recommends that $40,000 be advanced now and the balance of $10,000 be paid when the building is completed and the liens have expired.

Your committee further recommends that the Finance Committee be authorized to draw on the Treasurer of the University for the said sums of $40,000 and $10,000, upon receiving a certificate from J. B. Mhoon, Counsel of the Board of Regents, to the effect that the title to said property is in James B. Lankershim. [Concurred in, on a call of the ayes and noes, June 9, 1896.]

Partial Release to W. A. Knowles.—Regent Martin submitted the following:

Resolved, That upon payment of one hundred and twenty (120) dollars, to the Treasurer of the University of California, the Chairman of the Committee on Grounds and Buildings, by and with the consent of said committee, be and is hereby authorized and instructed to make, execute, and deliver a partial release of the mortgage to the Regents of the University of California, dated the 6th day of December, 1890, and recorded in liber 355 of mortgages, at page 261, in the Recorder's office of Alameda County, State of California; that is to say, to release from the lien of said mortgage lots Nos. 2 and 3 in Block E, according to the map entitled "Map of Broadway Terrace, Oakland, Alameda County, State of California," filed October 2, 1890, in the County Recorder's office of Alameda County, said map being a subdivision map of the tract of land covered in mortgage. The Secretary of this Board is authorized to attest release under the seal of the University. [Adopted, on a call of the ayes and noes, February 19, 1896.]

18. DELINQUENT INTEREST.

Regent Miller, on behalf of the Finance Committee, submitted the following:

Your committee recommends that the rate of interest charged against delinquent interest be compounded monthly at the rate of 8% per annum, and that this regulation be inserted in all new mortgages. [Concurred in, on a call of the ayes and noes, October 8, 1895.]

19. OPINION OF ATTORNEY-GENERAL IN RELATION TO ACT APPROPRIATING INTEREST ON DIVERTED FUNDS.

SAN FRANCISCO, January 22, 1896.

State Board of Examiners, Sacramento, Cal.:

GENTLEMEN: In the matter of the claim of the University of California for $2,392 50, as semi-annual interest on diverted funds, presented under an Act approved March 3, 1893 (Stats. 1893, p. 75), and to your question as to whether or not there are two appropriations in the Act referred to, I am of the opinion that there is but one appropriation in the Act, viz.: an appropriation, as expressed in the title, to pay the interest on the outstanding bonds of the State of California held in trust for the University Fund and the State School Fund.

I am further of opinion, however, that the claim under consideration should not be allowed. It is for the interest at 6% per annum on $79,750 heretofore appropriated to the Endowment Fund of the University, "but by mistake held therefrom and used for other State purposes" (Stats. 1881, p. 50). By an Act approved March 4, 1881, it was provided the sum of $4,785 was annually appropriated to the University, which appropriation was to continue until the State should elect to return to the Endowment Fund of the University the diverted fund above referred to. This Act was repealed in terms by the Act approved March 3, 1893; and by Section 2 of the Act of 1893, the sum of $24,922 50 was appropriated semi-annually to pay the interest at the rate of 6% per annum on the outstanding bonds held by the University against the State, of the face value of $751,000, "to which," says the Act, "is added the sum of $79,750 also belonging to said Endowment Fund of said University, the interest on which has heretofore been provided for by the Act of March 4, 1881."

This latter provision, however, in regard to the $79,750, is not covered by the title of the Act; for the sole purpose of the Act, so far as the title expresses it, is to repeal the Act of March 4, 1881, and "to provide for the payment of interest on the outstanding bonds of the State of California held in trust for the University Fund and the State School Fund." Therefore, that portion of the Act itself which authorizes the payment of interest upon this diverted fund is not embraced within the title of the Act, and is to that extent unconstitutional. The only interest that can be paid under the Act is interest on the bonds, which must be segregated from the interest on the diverted funds.

I return the claim.

Respectfully,

W. F. FITZGERALD,
Attorney-General.

20. Orders on State Treasurer.

Order on the State Treasurer for the Withdrawal of State Appropriation for the Erection of Buildings for the Affiliated Colleges.—Regent Miller, on behalf of the Finance Committee, submitted the following resolution:

Resolved, That the President of this Board is directed to draw from the State Treasury, upon an order drawn upon the State Controller for a warrant on the State Treasurer in favor of the Treasurer of the University of California, at any time during each fiscal year ending June 30th, any or all money appropriated by the Legislature of the State of California, for the uses of the Regents of the University of California for the forty-seventh and forty-eighth fiscal years, under an Act entitled "An Act appropriating $250,000 for the erection of buildings for the use of affiliated and other departments of the University of California," approved March 23, 1895. [Adopted August 13, 1895.]

Order on the State Treasurer for the Withdrawal of State Appropriation for the Promotion of the Viticultural Interests of the State.—Regent Hallidie, Chairman of the Finance Committee, submitted the following:

Resolved, That the President of this Board is directed to draw from the State Treasury, upon an order drawn upon the State Controller for a warrant on the State Treasurer in favor of the Treasurer of the University of California, at any time during each fiscal year ending June 30th, any or all moneys appropriated by the Legislature of the State of California, for the uses of the Regents of the University of California for the forty-seventh and forty-eighth fiscal years, under an Act entitled "An Act to repeal Sections 1, 2, 3, 4, 5, 6, 7, and 10 of an Act entitled 'An Act for the promotion of the viticultural industries of the State,' approved April 15, 1880, also an Act entitled 'An Act to define and enlarge the duties and powers of the Board of State Viticultural Commissioners and to authorize the appointment of certain officers, and to protect the interests of horticulture and viticulture,' approved March 4, 1881; also, an Act entitled 'An Act to enlarge the duties of the Board of State Viticultural Commissioners,' approved February 26, 1885, to provide for completion of unfinished work, for the transfer of the property of the Viticultural Commissioners, and making an appropriation therefor." [Adopted July 23, 1895.]

Orders on the State Treasurer for the Withdrawal of Principal of Redeemed Bonds.—Regent Hallidie submitted the following on behalf of the Finance Committee:

Resolved, That the State Treasurer is hereby requested to deliver to Louis Sloss, Treasurer of the University of California, the sum of one thousand (1,000) dollars now deposited in the State Treasury to the credit of the Consolidated Perpetual Endowment Fund of the University of California, being principal of Plumas County Bond No. 19, or in the event of said sum not being paid into the State Treasury, that the State Treasurer is requested to deliver to Louis Sloss, Treasurer of the University of California, for collection and investment, Plumas County Bond No. 19, being a bond, par value of $1,000, now in the hands of the State Treasurer to the credit of the Consolidated Perpetual Endowment Fund of the University of California, upon presentation of this resolution, certified by the Secretary and indorsed by the Governor of the State, requiring the same. [Adopted April 14, 1896.]

Resolved, That the State Treasurer is hereby requested to deliver to Louis Sloss, Treasurer of the University of California, the sum of fifty thousand (50,000) dollars now deposited in the State Treasury to the credit of the Consolidated Perpetual Endowment Fund of the University of California, being principal of Marin County Railroad Subsidy Bonds Nos. 21 to 70, both inclusive, and Nos. 121 to 170, both inclusive, or in the event of said sum not being paid into the State Treasury, that the State Treasurer is requested to deliver to Louis Sloss, Treasurer of the University of California, for collection and investment, Marin County Railroad Subsidy Bonds Nos. 21 to 70, both inclusive, and Nos. 121 to 170, both inclusive, being one hundred bonds, par value of $500 each, now in the hands of the State Treasurer to the credit of the Consolidated Perpetual Endowment Fund of the University of California, upon presentation of this resolution, certified by the Secretary and indorsed by the Governor of the State, requiring the same. [Adopted April 28, 1896.]

Order on the State Treasurer for the Payment of the "Morrill College Aid Fund."—Regent Hallidie, Chairman of the Finance Committee, submitted the following:

Resolved, That Levi Rackliffe, Treasurer of the State of California, be and he is hereby requested and authorized to pay over to Louis Sloss, Treasurer of the University of California, the sum of $21,000, the seventh annual installment received under the Federal appropriation for the benefit of the Agricultural and Mechanic Arts Colleges, by an Act approved August 30, 1890, commonly called the Morrill College Aid Act. [Adopted July 23, 1895.]

21. Tuition Fee.

Regent Foote called up the report of the Joint Committee (Finance and Internal Administration) in relation to tuition fees, as follows:

Whereas, Owing to the great increase in the number of students attending the colleges at Berkeley during the last four years, amounting to fully one hundred per cent, and the large number of young men and women awaiting and demanding admission to the University, the Board of Regents finds itself unable to provide the means required to maintain the several departments of the University in an efficient and satisfactory manner, except by resorting to the imposition of a rate of tuition; therefore,

Resolved, That a tuition fee of $25 per academic year be required of all students, payable in two installments of $12 50 each at the beginning of each semester; provided, that the holders of scholarships now established and the holders of seventy-five scholarships to be established by this Board, shall be exempt from the payment of this tuition fee;

Resolved, That the Board of Regents does hereby establish seventy-five free scholarships to be awarded under the direction of the Faculty, to worthy students unable to pay tuition fees.

Counsel Mhoon reported verbally that it was in the power of the Board to charge tuition fees.

On a call of the ayes and noes, the resolutions recommended by the committee were rejected. [July 9, 1895.]

22. Incidental Fee.

Regent Hallidie moved that the Board take up for consideration the report of the Finance Committee on the recommendation of the Internal Administration Committee that an incidental fee of $10 a term be charged the students.

Seconded by Regent Miller.

Regent Marye moved as an amendment to Regent Hallidie's motion that said report and the report of the Ways and Means Committee be taken up for consideration together.

Seconded by Regent Kellogg, and carried.

Regent Hallidie's motion as amended by Regent Marye was then concurred in on a call of the ayes and noes.

The recommendation of the Finance and Internal Administration Committees that a fee of $10 a term be charged for incidentals was then discussed, and, on a call of the ayes and noes, was not concurred in. [June 9, 1896.]

23. Change of Board Room.

Regent Hallidie offered the following resolution:

Resolved, That the room and adjoining anteroom on the second floor of the Hopkins Institute of Art, on the southwest corner, be set aside for the exclusive use of the Regents, and that all meetings of the Board to be held in San Francisco hereafter be held in above rooms. [Adopted April 14, 1896.]

24. Adoption of Metric System Indorsed.

President Kellogg submitted the following:

A communication urging active measures to secure the adoption of the metric system. Prof. George Davidson asks the signatures of our Regents and Faculty in its favor.

Regent Houghton offered the following resolution:

Resolved, That the Board of Regents of the University of California fully indorse and recommend the passage of the bill now before Congress to adopt the metric system of weights and measurements, as provided in H. R. 7251 of 1st Session of 54th Congress. [Adopted April 14, 1896.]

25. Invitation from Princeton University.

President Kellogg submitted the following:

An invitation has been received from Princeton University, asking that this University be represented at the one hundred and fiftieth anniversary of the founding of that institution. It is possible that Professor Le Conte will be able to attend the celebration, which will take place October 22, 1896. I suggest that a suitable answer be made to the invitation, in the name of the Board of Regents, and that Professor Le Conte be named as our representative. [Approved April 14, 1896.]

26. PETITION OF STUDENTS FOR LOCKERS IN THE GYMNASIUM.

Regent Marye submitted the following from the Committee on Internal Administration:

The petition of the Juniors and Seniors for the return of lockers in the Gymnasium which have been taken from them and assigned to lower classmen. Your committee feels compelled to recommend that this request be declined, for the reason that Physical Culture is compulsory on the lower classmen and not on the higher classmen. [Concurred in October 8, 1895.]

27. DONATION OF FUND FOR THE AID OF WORTHY STUDENTS.

President Kellogg reported the following:

Mrs. J. H. Rosewald has made, through Professor Jones, the offer of a fund for the aid of worthy students who need assistance, in memory of Professor Rosewald, lately deceased. The money so donated will not be available at present, but meantime she hopes to pay in a yearly amount corresponding to the prospective income from the fund.

On motion, Mrs. Rosewald's offer was accepted, and the Secretary was instructed to make suitable acknowledgment. [November 12, 1895.]

28. APPROPRIATION FOR VISITING SCHOOLS.

Regent Hallidie, Chairman of the Finance Committee, submitted the following report:

The President of the University states that the increase of the number of students during the current academic year is so large that the income derived from laboratory deposits will be about $1,000 in excess of the amount estimated in the Annual Budget of 1895–96, and he therefore advises that that amount be appropriated to cover the cost of visiting schools. Your committee submits the statement without recommendation.

Regent Black moved that the sum of $1,000 be appropriated for the foregoing purpose. [Concurred in, on a call of the ayes and noes, January 14, 1896.]

29. TRAVELING EXPENSES FOR VISITING SCHOOLS TO BE ADVANCED.

Regent Hallidie, Chairman of the Finance Committee, submitted the following:

In visiting the schools throughout the State, the Professors have themselves advanced the money to cover the necessary traveling expenses. Your committee recommend that the Finance Committee be authorized to advance the money upon receiving from the intended traveler a minimum estimate of the cost of the journey, approved by the head of the department and the President of the University. [Concurred in, on a call of the ayes and noes, June 9, 1896.]

30. Professor Hilgard's Contingent Fund Increased.

Regent Hallidie, Chairman of the Finance Committee, submitted the following:

Your committee submit a request from Professor Hilgard for an addition of $50 to the contingent fund of his department, and recommend that the request be granted. [Concurred in, on a call of the ayes and noes, June 9, 1896.]

31. Degrees Conferred by the Board of Regents.

July 9, 1895, the degree of M.D. upon the following-named graduates:

Joseph Crisanto Badilla.
William Benjamin Franklin Barbat.
William James Robert Boyes.
Augustus Frank Brown.
Frank Wilburn Dudley.
Daniel Elisha Foote Easton.
Horatio Bates Emerson.
Adelina Minnie Feder.
John Joseph Flood.
Robert Frederick Gray.
William Gilbert Hay.
Clarence Louis Heller.
George Leo Helms.
Edward Kimball Hopkins.
James Porterfield Hull.
George Edward Hyde.
Frederick Andrew Lutz.
Thomas Adam McCulloch.
Hammond Johnson McCallum.
John Ernst Nast.
Frederick Augustus Rinne.
Mary J. Sankey.
Charles Joseph Schmelz.
William Augustus Trafton.
Albert J. Villani.
Bertram Stone.

September 10, 1895, the degree of Master of Arts on the following-named graduate:

William Ferdinand Larsen ---- San Rafael.

September 10, 1895, the degree of Bachelor of Science upon the following-named graduate:

Milo Samuel Baker ---- Watsonville.

October 8, 1895, the degree of Bachelor of Science upon the following-named graduate:

Miss Katherine Camilla Wambold ---- Los Angeles.

November 12, 1895, the degree of Ph.G. upon the following-named graduates:

Charles Jacob Abraham	San Francisco.
Richard Jones Baily, M.D.	San Francisco.
Charles Alfred Bayly, Jr.	San Francisco.
Frank Charles Becker	Merced.
Joseph Hildreth Brown	Oakland, Or.
John Francis Christopher	Los Angeles.
Harold Skinner Cottle	San José.
J. Wirt Cummins	San Francisco.
Franklin Thomas Duncan	Tustin.
Charles Devans Fairbanks	Salinas.
Carl Torvald Lauritz Gydison	San Francisco.
George Walker Hawkins, M.D.	San Rafael.
Pratt Cook Inman	Placerville.
Adial Sabin Jones	San Francisco.
Joseph Louis Lengfeld	San Francisco.
Henry Milton McQueen	Jacksonville, Or.
Harry Louis Miller	San Francisco.
Leo Munter	San Francisco.
John Crockett Newton	San Francisco.
Silvio Joseph Onesti	San Francisco.
Walter Corwin Powell	Marysville.
Charles Christopher Rubel	San Francisco.
Haydn Mozart Simmons	San Francisco.
Frederick George Ulman	Elk Grove.
Nicolas Roberts De Urumela	San Francisco.

December 10, 1895, the degree of Bachelor of Arts upon the following-named graduate:

Frederick Randolph King .... Belmont.

December 10, 1895, the degree of Bachelor of Philosophy upon the following-named graduate:

Willard Dawson Thompson .... 136 S.W. Temple St., Salt Lake City, Utah.

December 10, 1895, the degree of Bachelor of Letters upon the following-named graduates:

Miss Bertha Oliver .... 343 S. Bunker Hill Avenue, Los Angeles.
Miss Rachel Vrooman .... 1167 Oak Street, Oakland.

January 14, 1896, the degree of M.D. upon Miss Rose Eppinger.

February 11, 1896, the degree of Bachelor of Letters upon the following-named graduates:

Sidney Myer Ehrman .... 1900 Washington Street, San Francisco.
Edward Leodore Mayberry, Jr. .... 244 South Broadway, Los Angeles.

February 11, 1896, the degree of Bachelor of Philosophy upon the following-named graduate:

Walter Otto Smith .... 1628 Oxford Street, Berkeley.

February 11, 1896, the degree of Bachelor of Science upon the following-named graduate:

Frederick William Koch .... Twin Oaks, San Diego County.

April 14, 1896, degree of M.D. upon August Leon Jerome Lartigan.

May 13, 1896, the degree of Doctor of Philosophy upon the following-named graduates:

Harold Wellman Fairbanks .... Berkeley.
Frederick Leslie Ransome .... Berkeley.

May 13, 1896, the degree of Master of Arts upon the following-named graduates:

Walter Huddleston Graves .... Oakland.
Paul John Mohr .... Berkeley.
Eugene Pitcher .... Berkeley.
Evelyn Louise Sheppard .... San Francisco.

May 13, 1896, the degree of Master of Letters upon the following-named graduates:

Edith Martin Clayes .... Berkeley.
Annie Lucy Inskeep .... Oakland.
Etta Evangeline Moore .... Klamath Falls, Or.
Oscar Sutro .... San Francisco.
Mary Elizabeth Wilson .... Oakland.

May 13, 1896, the degree of Master of Science upon the following-named graduates:

Frank Watts Bancroft .... Walnut Creek.
Elmer Edgar Hall .... Pasadena.
Selina Sharpe .... Oakland.
Myer Edward Jaffa .... San Francisco.
Augustus Valentine Saph .... Oakland.

May 13, 1896, the degree of Bachelor of Arts upon the following-named graduates:

Francis Herbert Dam	Wheatland.
Harry Dale Danforth	Oakland.
Clara Augusta Henry	Porterville.
Guy Hinton	San Francisco.
Lillie Unna Kalman	Alameda.
Tracy Randall Kelley	Fresno.
Theodore de Leo de Laguna	Oakland.
George Jewett McChesney	Oakland.
Alma Michalitschke	San Francisco.
George Davis Louderback	San Francisco.
Arthur Walbridge North	Winters.
Thos. Allen Perkins	San Francisco.
William Thomas Plunkett	San Francisco.
Frank Everett Sawyer	San Francisco.
Mabel Symmes	San Francisco.

May 13, 1896, the degree of Bachelor of Letters upon the following named graduates:

Jessie Mabel Anderson	San Francisco.
Helen Milton Andros	San Francisco.
Frank Argall	Grass Valley.
Laura Louise Bartlett	Berkeley.
Eleanor Vanderbilt Bennett	Oakland.
Elizabeth Blanchard	San Francisco.
Bertha Theresa Bradley	Berkeley.
Carrie Bruere	Los Angeles.
Milton L. Choynski	San Francisco.
Clyde Algernon Allen Cross	San Francisco.
Edith Florence Culin	Berkeley.
Milton Herman Esberg	San Francisco.
Ethel Ruby Farnham	Oakland.
Maybelle Louise Feusier	San Francisco.
Galen Merriam Fisher	Oakland.
John Darwin Gish	Los Angeles.
Josephine Pauline Ginaca	San Francisco.
Sarah Maud Green	Petaluma.
Louise Josephine Hawkins	Oakland.
Nora Ellen Hussey	Nevada City.
Ada Gertrude Little	Berkeley.
Eula Mitchell	North Temescal.
Joseph O'Connor	San Francisco.
Clara Jeanette Pearne	Berkeley.
Lulu Adele Ruch	North Temescal.
Mabel Worthington Sullivan	Santa Cruz.
Bertha Sweet	San Francisco.
Lou Dexter Whipple	Los Angeles.
John Lewis Wittenmyer	Martinez.
Essie Belle Woodland	San Francisco.
Estelle May Young	San Francisco.

May 13, 1896, the degree of Bachelor of Philosophy upon the following-named graduates:

Arthur Agard	Oakland.
Bukio Arata	Kagookimaken, Japan.
Alexander Richards Baldwin	San Francisco.
Etta May Bartlett	Berkeley.
Harriet Erneste Bienenfeld	San Francisco.
James Philip Davis	Hollister.
Mabel Anita Fisher	Berkeley.
Martin Charles Flaherty	San Francisco.
William Nathaniel Friend	Oakland.
Maud Bingham Hansche	Oakland.
Charles Roscoe Holton	Selma.
John Power Hutchins	San Francisco.
Katherine Davies Jones	Berkeley.
George Dudley Kierulff	Berkeley.
Freeman Mills Kincaid	Compton.
Christine Blanche Labarraque	Tres Pinos.

Miriam Livingston	San Francisco.
Milton Albert Lippitt	San Francisco.
Ina Cameron Martin	San Francisco.
Alexander McCulloch	San Francisco.
Anabel McDonnell	Berkeley.
Clinton Ralza Morse	Berkeley.
Newel Lewis Perry	Berkeley.
Benjamin Hatch Ramsdell	Alameda.
William Gladstone Spiers	Berkeley.
Ruby Willard Studley	San Francisco.
Harry Clinton Symmes	Berkeley.
Albert Owen Warner	Fresno.
Roswell Samuel Wheeler	Alameda.
Caroline White	San Francisco.
Homer Miller Wilson	Oakland.
Herbert Coke Wyckoff	Berkeley.

May 13, 1896, the degree of M.D. was conferred upon the following-named graduates:

Clifford Emmett Allen.
Helen Orastella Anderson.
Cecil Miller Armistead.
Louis Dominic Bacigalupi.
Henry Martin Beck.
Sanford Blum.
Mary Elizabeth Botsford.
George Anthony Broughton.
William Parker Burnham.
Howard McDougall Cameron.
William d'Arcy Chase.
Leonard Hayes Coe.
Thomas Francis Joseph Cox.
Grace Feder.
Attilio Henry Giannini.
Joseph Thomas Harrigan.
Ichitaro Katsuki.
James Frederick Kearney.
Wilfred Harvey Kellogg.
Arthur Stanley Lee.
Thomas Davis Maher.
Clarence La Fayette Maloon.
Charles Lewis Morgan.
Howard Morrow.
James Daniel Murphy.
Brayton Muscott.
Charles Dominic McGettigan.
Alfred McLaughlin.
Alfred Newman.
Mary Louisa Noble.
Robert Harris Orr.
John Henry O'Brien.
John Thomas O'Brien.
William Henry Ingram O'Malley.
George Lewis Painter.
Wallace Ernest Parkman.
Victor Eugene Putnam.
Joseph Rochex.
Marshall Bragg Ryer.
Florence Scott.
John Thomas Stafford.
Arthur Alonzo Stern.
Mary Jane Stewart.
Mack Voorhees Stone.
William Miller Stover.
Eleanor May Stow.
Lewis Sanborn Thorpe.
Henry Caustin Trask.
Alberto Trevino.
Newton Booth Waller.

May 13, 1896, the degree of Bachelor of Science upon the following-named graduates:

William Belfrage	San Francisco.
Edith Sumner Byxbee	Fruitvale.
Silas Ellsworth Coleman	Glendale.
Harrington Bidwell Graham	Chico.
John Gilson Howell, Jr.	Colfax.
Emily Patricia Rhine	San Francisco.
Mildred Mary Taylor	Berkeley.
Mertie R. Thompson	San Francisco.
Thomas Farrington Sedgwick	Berkeley.
George Kirk Swingle	Davisville.
Edwin Tyler Blake	Berkeley.
Edwin Ruthven Cox, Jr.	Ahtera, Or.
Edward James Crawford	Berkeley.
Charles Henry Delany	Berkeley.
William Joseph Drew	Berkeley.
Richard Fenner Monges	San Francisco.
Sanford Alexander Moss	San Francisco.
George Oscar Noble	Los Angeles.
Clarence Henry Norwood	Golden Gate.
Howard Potter Veeder	Berkeley.
Gilbert Stoddard Walker	Los Angeles.
Phil Read Bradley	Bradley.
Fred Albert Bordwell	Alameda.
Arthur Brown, Jr.	Oakland.

Albert Edward Chandler	San Francisco.
Anthony White Dozier	North Temescal.
Lee Swaney Griswold	Oakland.
Harry Herbert Hirst	Berkeley.
William Morris Hyman	Woodland.
Frank Gustave Radelfinger	Napa.
Frank Elmore Ross	Berkeley.
Shinjiro Yamamoto	Hikata, Wakayama, Japan.
Harry Lincoln Alexander	Los Angeles.
Herbert William Allen	Oakland.
Rachel Leona Ash	San Francisco.
Frederick Gardiner Cottrell	Oakland.
Arthur Lamence Fisher	San Francisco.
William Harrington Hollis	San Francisco.
Edwin Rushmore Jackson	Oakland.
Alva Dutton Stearns McCoy	Pasadena.
Raymond John Russ	Oakland.

May 19, 1896, the degree of Bachelor of Laws upon the following-named graduates:

Everett Ames	Oakland.
Leo Bethel Archer	San José.
John Joseph Barrett, B.S.	San Francisco.
Thomas Joseph Barry	Grass Valley.
Louis de Fontenay Bartlett, Ph.B.	San Francisco.
Louis Lazarus Bernheim, Ph.B.	Santa Cruz.
Ernest Chappell Bonner, Ph.B.	Cedarville.
Herbert Sampson Bradford	San Francisco.
Walter Scott Brann, Ph.B.	San Francisco.
John Foster Clute	Volcano.
Edwin Theodore Cooper	San Francisco.
Aylett Rains Cotton, Jr., A.B.	San Francisco.
Thomas Drummond Davidson, A.B.	San Francisco.
William Dehy	Bishop.
Frederick William Dickson	Auburn.
Richard John Dillon, A.B.	Los Angeles.
George Herbert Fletcher, Ph.B.	Grass Valley.
Lewis Alberto Gibbons, A.B.	College City.
Robert William Gillogley	San Francisco.
Francis Peter Haynes, B.S.	San Francisco.
Horace Caldwell Head, Ph.B.	San Francisco.
Walter Hughes Henry, Ph.B.	Oakland.
William Penn Humphreys, Jr., Ph.B., A.B.	San Francisco.
Frank Krull, B.S.	San Francisco.
Sylvain Jules Lazarus	San Francisco.
John Alfonsus Edward Lenahan, B.S.	San Francisco.
Frederick Charles Loofburrow	Salt Lake City, Utah.
Harley Phillips Matthewson, A.B.	Los Angeles.
Clifford McClellan	Lorin.
Benjamin Louis McKinley, A.B.	San Francisco.
Thomas Stephen Molloy, A.B.	San Francisco.
Robert Head Morrow, Ph.B.	San Francisco.
Thomas Henry Nicholls	Dutch Flat.
Charles Francis O'Callaghan	San Francisco.
John O'Gara, A.M.	San Francisco.
Thomas Allen Perkins, A.M.	San Francisco.
Leon Edward Prescott	San Francisco.
Robert Martin Price, Ph.B.	San Francisco.
Charles Samuel Rosener	San Francisco.
John Albert Sanborn	Fruitvale.
Edward Percival Shortall	San Francisco.
James Wilson Smith	Santa Barbara.
Stephen Leslie Sullivan, A.M.	San Pablo.
Howard Thompson Trumbo	Salt Lake City, Utah.
John James Van Nostrand	San Francisco.
Carl Westerfeld	San Francisco.
Charles Wesley Willard, A.B.	San Francisco.

June 9, 1896, the degree of Doctor of Dental Surgery upon the following-named graduates:

William Henry Abbay	Oakland.
Henry Abrahm	San Francisco.
George Abrams	San Francisco.
Marilda Jane Ayers	Eureka.
Frederick Guernsey Baird	Lodi.
Bertram Carl Boeseke	Santa Barbara.
Franklin Calvin Bonnel	Tres Pinos.
Charles Harold Bowman	Santa Cruz.
Albert Caferata	San Francisco.
Paul Tulane Carrington	Oakland.
Harry George Chappel	San José.
William Nathan Clark	Watsonville.
Frank Herman Cranz	San Francisco.
Jacob Cohn	Boise City, Idaho.
Stephen Joseph Cunningham	San Francisco.
William Edward Davis	San Francisco.
James Morton Forrest, Jr.	Los Gatos.
Arthur A. Fowler	San José.
H. Edward Gedge	San Francisco.
Charles Daniel Gilman	Oakland.
Lawrence Greenbaum	San Francisco.
Richard George Cornelius Harms	Oakland.
Charles Edwin Hart	Pacific Grove.
Arthur Philip Harth	Grant's Pass, Or.
George Morgan Harris	Oakland.
Alexander Hamilton Hawley	Sacramento.
George Henry Haynes	Victoria, B. C.
Samuel William Hilliard	Lodi.
Guy Brown Husted	Saratoga.
Konrad Magnus Lundborg	San Francisco.
Stephen Cholmeley Maynard	San José.
Naoma Gae MacDonald	San Francisco.
Robert B. McNutt	San Francisco.
Thomas Snelling Morden	Boise City, Idaho.
Fred Gustave Pless	San Francisco.
Charles Bruce Porter, Jr.	San Francisco.
Joseph Ignatius Richards	San Francisco.
Leon Joseph Roth	Los Angeles.
Amy M. Gilbert	Grafton, N. S. W.
Anna Martin Sawyer	San Francisco.
John Herbert Seager	Constantinople, Turkey.
Frank Joseph Smith	San José.
George Edward Stallman	San Francisco.
Benjamin Mitchell Stich	San Francisco.
Montgomery Thomas	Fresno.
Oscar Tobriner	San Francisco.
Clifford Todd	Sacramento.
William Henry Ware	San Francisco.
Lauren David Webster	San José.
Clyde Allan Weldon	San Francisco.
Edward William Westphal	San Francisco.
Mary Louise Baird	Lodi.

Regent Marye, Chairman of the Committee on Internal Administration, reported that the incomplete form of recommendation for degrees submitted by the College of Dentistry at the meeting of the Board held June 9, 1896, and which was referred to the Committee on Internal Administration, had now been properly filled out and signed, and moved that the degree of Doctor of Dental Surgery be conferred as requested in the application. [Concurred in June 23, 1896.]

32. Award of the University Medal.

President Kellogg submitted the following communication from the Recorder of the Faculties:

Berkeley, May 11, 1896.

To the President:

Dear Sir: I have the honor to inform you that at a meeting of the Academic Council, held May 11, 1896, it was voted that Harry Herbert Hirst, a student in the College of Civil Engineering, be recommended to the Regents of the University as worthy to receive the University Medal for 1896, in accordance with the provisions of the donors.

This action by the Academic Council was ratified by the Faculty of the College of Civil Engineering, meeting on the 11th instant.

Very respectfully,

JAMES SUTTON,
Recorder of the Faculties.

On motion, the University Medal was awarded as recommended. [May 13, 1896.]

33. New Diplomas.

President Kellogg submitted a communication from Dr. L. L. Dunbar, Dean of the College of Dentistry, stating that Dr. Robert F. Gray, a graduate of this college, has made an application for a duplicate of his diploma, which was so much mutilated by an accident while in the hands of the framer, as to mar its appearance entirely.

Regent Marye moved that a new diploma be granted upon surrender of the old one to the Secretary of this Board and payment of the cost of the new one. [Carried April 14, 1896.]

Regent Marye submitted the following communication from Leonard Stone, Registrar of the Hastings College of the Law:

San Francisco, June 3, 1896.

To the Honorable the Board of Regents of the University of California:

Gentlemen: Mr. Charles Wesley Willard, upon whom your honorable body conferred the degree of LL.B. on May 19th last, complains that his name was incorrectly spelled in the diploma issued to him, and respectfully requests that upon surrender to you of the diploma heretofore received by him, your honorable body issue a new diploma bearing the same date as the original, but with the name correctly spelled.

Yours, very respectfully,

LEONARD STONE,
Registrar.

On motion, the request was granted. [June 9, 1896.]

President Kellogg submitted a communication from the Dean of the College of Pharmacy, stating that the diploma of Charles Devans Fairbanks had been accidentally mutilated, and asking that a new diploma be issued to him.

Regent Marye moved that a new diploma be granted upon surrender of the old one to the Secretary of this Board and payment of the cost of the new one. [Carried June 23, 1896.]

34. Accrediting Schools.

President Kellogg submitted the following resolution from the Academic Council:

Resolved, That the Academic Council recommend to the Board of

Regents that the second paragraph of the order of the Board regulating the accrediting of schools, be changed to read as follows:

> All applications made in accordance with the provisions of the foregoing paragraph must be in the hands of the Recorder of the Faculties, at Berkeley, on or before the 1st day of December (instead of the 21st day of March following) of each school year.

It was further suggested that the date at which this change shall go into effect be left to the Committee on the Examinations of Schools in consultation with the President.

On motion, the recommendation of the Academic Council was concurred in, and the date on which the change shall go into effect was left to the discretion of the President and the Committee on Examinations of Schools. [September 10, 1895.]

President Kellogg reported as follows:

The Hoitt School failed to ask for accrediting within the required time. I move that an exception be made this time in its favor; a request for accrediting has now been received.

On motion, it was ordered that an exception be made in this case. [April 14, 1896.]

35. NAVAL ENGINEERING.

Regent Bartlett submitted the following from the Committee on Internal Administration:

The President has received several communications, accompanied by various newspaper articles, concerning a bill introduced in the House of Representatives at Washington by the Hon. Mr. Wilson, of New York. The title of the bill is as follows: "A bill to organize and increase the efficiency of the personnel of the Navy; to increase the usefulness and numbers of the Corps of Naval Engineers; to induce the scientific institutions to provide a naval-engineering reserve for time of war; to establish a naval-engineering experimental station, and to encourage the study of the mechanic arts and sciences, and particularly that of naval engineering, in the technological colleges of the country."

Many institutions are taking a great interest in this bill, and it is favorably commented on by leading journals, such as the Army and Navy Journal. It proposes an increase in the active list of the Engineer Corps of the Navy, the present number being quite inadequate. It provides for the appointment of engineer cadets at the U. S. Naval Academy, in the manner in which the naval cadets are appointed. Section 13 provides that approved graduates of technological schools, within a specified number, shall be eligible for appointment as engineer cadets, in addition to those appointed from the cadets of the Naval Academy. This will open many desirable positions to graduates of the technological schools. Section 14 also provides that the Secretary of the Navy may detail an officer of the Engineer Corps to each technological school or college, as Professor of Naval Engineering.

These are advantages which may well enlist the active interest of institutions having technical courses of instruction.

The committee recommend that the Board of Regents authorize the President to send, in the name of the Board, a communication to both our Senators, and to all the Representatives from this State, urging them to favor the above-mentioned bill, and to interest themselves in securing its passage. [Concurred in February 11, 1896.]

36. Bill for Adjustment of Grants of Land.

A Bill to Make an Equitable Adjustment of the Grants of Land to the Several States of the Union for Seminaries of Learning or Universities.

Whereas, In general accordance with the compact embodied in the ordinance of July 13, 1787, Congress has granted to each of the States formed out of the public domain, upon its admission into the Union, a portion of the public lands within the State, for maintaining a seminary or university; and

Whereas, These grants have not been made upon an equitable basis, some States having received none, some having received two townships of land, some three, and some four or more; and

Whereas, The grants thus made are in every case altogether inadequate to meet the present needs of that form of education which they were intended to foster in the several States; and

Whereas, By the Act of July 2, 1862, and by other subsequent Acts relating to the agricultural and mechanical colleges, Congress has recognized the importance of placing the means for thorough education within reach of all the people of the States of the Union, and by these Acts has given in all the States considerable aid to certain branches of education;

(1) Therefore, *Be it enacted*, etc., That there should be, and is hereby granted to the several States of the Union, under the conditions and for the purposes hereinafter stated, an amount of public land, to be apportioned to each State a quantity equal to thirty thousand acres for each Senator and Representative in Congress to which the States are respectively entitled by the apportionment under the census of 1890.

(2) From the number of acres which would thus be granted to the States which have heretofore received grants for seminaries or universities, shall be deducted the amount which has been granted by Congress to these States for seminaries or universities by what are commonly known as the seminary or university grants, and these said States shall receive under this Act the difference between what they would receive under the provision of section one of this Act and the amount of land already granted to each for a seminary or university.

(3) The land granted by this Act, after having been surveyed, shall be apportioned to the several States in sections or subdivisions of sections not less than one quarter of a section, and the Secretary of the Interior is hereby authorized and directed to issue to each of the States of the Union land scrip for the amount in acres to which said State may be entitled under the provisions of this grant, said scrip, or the proceeds thereof, to be applied to the uses prescribed in this Act, and to no other use or purpose whatsoever.

(4) All moneys derived from the sale of the land scrip aforesaid by each State to which the scrip is apportioned, shall be deposited in the treasury of said State, which shall issue therefor a certificate of indebtedness, bearing interest perpetually at a rate of not less than five per centum per annum; and the proceeds of said land scrip shall constitute a perpetual fund, the capital of which shall remain forever undiminished, and the interest of which shall be inviolably appropriated by each State to the endowment, maintenance, and support of the

State University therein, or for such other seminary or seminaries of learning within said State as have been founded upon or maintained by the grants of land made by Congress to said State, as the Legislature of said State shall determine; and in other States to which no grants for seminaries or universities have heretofore been made, this interest shall be inviolably appropriated to the endowment, maintenance, and support of some institution of higher learning within the State, which shall be designated by the Legislature, and the moneys or interest aforesaid shall be used for no other purpose than those above mentioned.

37. Rules for the Guidance of University Officers.

President Kellogg submitted the following matters:

Certain communications emanating from the Agricultural Department which appeared in the "Morning Call," had degenerated into personalities.

Believing this not to be good policy, after consultation with the Committee on Internal Administration, I formulated the following rule for the guidance of University officers:

> The University is not to antagonize any State institution or commission. This can only lead to needless trouble and opposition to the University.

Furthermore, the University cannot afford to allow any of its men, as individuals, to antagonize such institution or commission. They cannot act in an individual capacity without involving the University. People at large will not make the distinction.

Regent Chase moved that the rule formulated by President Kellogg be approved as the sense of the Board. [Carried October 8, 1895.]

A letter from Ellwood Cooper, of Santa Barbara, making charges against a member of the Agricultural Department, was read; also, a letter from Abbot Kinney, of Santa Monica, complaining of the condition of the Santa Monica Forestry Station.

A letter from Professor Hilgard was then read.

On motion, President Kellogg was authorized to write to Professor Hilgard and express to him the confidence of the Board in his administration. Also, that the Board of Regents are of the opinion that an investigation is not needed to defend him against the aspersions of his accusers.

The following is a copy of the letter addressed to Professor Hilgard:

BERKELEY, October 9, 1895.

DEAR PROFESSOR HILGARD:

It gives me pleasure to inform you that the Board of Regents of the University, at their meeting yesterday, instructed me to communicate to you the following minute adopted *nemine contradicente*:

The Board of Regents express their entire confidence in Professor Hilgard's administration of his department, and are of the opinion that no investigation or inquiry of any kind is needed to vindicate him from the aspersions of his accusers.

Yours respectfully,

MARTIN KELLOGG,
President University of California.

38. Culvert on Oxford Street.

Regent Houghton submitted the following report:

The special committee to whom was referred, with power to act, the matter of extending the culvert for carrying the water of Strawberry Creek across Oxford Street, beg leave to report that they have made a contract with Mr. H. R. Lamb for the same, in the sum of nine hundred and four (904) dollars, in addition to which the Electric Railroad Company pays for that portion beneath their ties.

On a call of the ayes and noes, the report was approved and the sum of nine hundred and four (904) dollars was appropriated. [July 9, 1895.]

39. Report of Committee on Grounds and Buildings in re Professor Leuschner's Request for Dwelling on University Grounds.

Regent Martin submitted the report of the Committee on Grounds and Buildings, as follows:

In the early history of the University, before the town of Berkeley had developed into a populous community with capacity sufficient to maintain the official connections that would ultimately grow up with and around it, the Regents had considered plans looking to the necessity of providing homes for the President, the professors, and indeed, the whole teaching force of the University. These homes were looked forward to by those who, in the early days, filled these respective positions, with great hopes of their realization, and some doubtless would have been constructed, but for the reason that money was not superabundant at that time, and from the fact that the first President had a home of his own, and some that succeeded him provided for themselves outside of the University grounds. The professors and students, following these examples, soon found places of entertainment with the numerous families that gradually came to Berkeley to reside. The long delay in carrying out the first policy of erecting the buildings referred to, held matters in abeyance and created grave doubts as to whether the Regents would ever finally carry out that part of their plan, and led many of the professors having families to purchase and build their own homes in the town of Berkeley, adjacent to the University grounds, until finally the Regents, finding all comers well provided for, gave up the idea of providing the costly structures they had in contemplation; and now the whole matter is lost sight of and has not been referred to for years.

These preliminaries are mentioned in the report, because, at a previous meeting of the Board a communication had been received from Professor Leuschner somewhat reviving former theories and proposing to erect a private residence, at his own expense, according to his own plans, on the University grounds near the Observatory, to be used exclusively by him and his family during his entire official connection with the University. The structure is to revert to the University, and the money expended by the Professor for construction, etc., is to be refunded to him.

The communication was referred to the Committee on Grounds and Buildings for investigation and report. The committee is not in possession of anything further than the original communication and a form of special contract in use at Haverford College, where similar privileges sought by Professor Leuschner are evidently granted on the college grounds, under certain restrictions. Whether the Regents wish to enter upon this new field is a question that ought to be settled now, as their action in this matter will be a precedent in future cases, and there may be others come up for consideration. If the Regents conclude to grant this privilege as requested, it will involve other matters of expense, such as furnishing water for consumption and irrigation, and light and sewerage connections. The principal advantage of conceding this privilege, would, of course, be to Professor Leuschner, by having a convenient residence at the Observatory, with the knowledge that whenever he might dissolve his connections therewith, the expenditure involved would return to him. College Way, a street in the Scenic Park tract, adjoining the University, is less than 300 feet distant from the Observatory, and a residence located on that street would be equally convenient as though on the University grounds.

The committee, after due consideration of the subject, herewith report adversely to granting the privilege.

On motion, the report of the committee was accepted and approved. [September 10, 1895.]

40. Request to Purchase or Rent a Portion of University Grounds for a High School Building.

Regent Martin submitted the following report:

The communication of the President of the Board of Education to your honorable body, with reference to the purchase or rental of a portion of the University grounds for the purpose of erecting a High School building thereon, was duly received and referred to the Committee on Grounds and Buildings. The site under consideration is the most elevated portion of the University grounds, fronting Oxford Street, Berkeley. This tract, in the opinion of the committee, is indispensable for the University, and will be necessary in the near future for University expansion in that direction. Neither does the committee favor any proposition for the dismemberment of the University grounds for any purpose whatever, and would therefore recommend that the Secretary of the University be instructed to inform the President of said Berkeley Board of Education, by letter, that their proposition either to purchase or rent will not be further entertained.

Recommendation concurred in. [September 24, 1895.]

41. Electrical Power.

Regent Martin submitted the following report:

The communication of Professor Cory, of the Mechanical and Electrical Arts Colleges, was duly received and read by your honorable body at a recent meeting of the Board, with reference to a proposition for furnishing electrical power to the several departments of the University, to wit: to the College of Mining, the College of Civil Engineering, the College of Agriculture, the College of Chemistry, the College of Physics, to the Printing Office, and other departments, and to partially light the University grounds, at an estimated expense of $560 for material, labor, etc. The communication was referred to the Committee on Grounds and Buildings for further information and report.

Your committee held a conference with Professor Cory on the subject of his communication, to ascertain whether any additional expense would be necessary to utilize the power when brought to the several colleges after the electrical connections were made.

The Chairman of the committee also attended a conference with the several heads of the respective departments interested, at the invitation of the President, when the whole subject was discussed, including the economy of the power and the saving which would result from its adoption, which would amount to $300 or $400 a year in fuel and labor alone, and would furnish motive power for other departments that have not been able to utilize the facilities they have on hand.

Your committee are deeply impressed with the economic aspect of the proposition and the facility afforded the colleges of having a power ever ready for use.

It would have been well had there been an earlier opportunity of availing ourselves of the use of electricity as a source of power, as it would have prevented large expenditures for machinery for shops and would have centralized such experimental matters entirely in the Department of Mechanics and Electrical Engineering, forming a central station from which we should depend for all motive power, for lighting purposes, and for heating the University buildings.

Your committee would earnestly recommend that the proposed appropriation of $560 be promptly made, if approved.

On a call of the ayes and noes, the sum of $560 was appropriated. [November 12, 1895.]

42. Plants from Golden Gate Park.

Regent Reinstein submitted a list of plants which are needed at the University, and moved that the Secretary be instructed to present a request therefor to the Commissioners of Golden Gate Park. [Carried December 10, 1895.]

The following is a list of the plants:

Areca lutescens.
Anthurium.
Aphelandra.
Aristolochia elegans.
Acalypha.
Aralias (warm house).
Caladiums: a few (foliage plant).
Clereodendron Balfourii.
Crotons.
Cycas cercinalis.
Cardulovica.
Centaurea.
Curculigo.
Dahlia bulbs.
Dieffenbachia.
Echeveria (white).
Lasiandra macrantha.
Lycopodium (white).
Maranta.
Mesembryanthemums in var.
Pandanua utilis.
Sphærogyne latifolia, or tocaco.
Sonerilla.
Tillandsia.
A few boxes of bedding plants.

43. Employment of Sanitary Engineer.

President Kellogg reported the following:

So much question has been raised as to the sanitary condition of one or two buildings at Berkeley, that I suggest the employment of a competent sanitary engineer to make the necessary investigations, and to report before the beginning of the Christmas vacation.

On motion of Regent Bartlett, the President's suggestion in relation to the employment of a competent sanitary engineer was approved, and the President was authorized to appoint such an engineer. [December 10, 1895.]

President Kellogg submitted the following report:

Mr. C. E. Grunsky has been employed to report on the sanitary needs of the college buildings at Berkeley, in pursuance of action taken at the last meeting of the Board. He has made a full report, indicating desirable changes which cannot be made until the summer vacation. He has also pointed out a few minor changes which should be made at once; and these changes are in progress under the supervision of the University plumber. [Approved January 14, 1896.]

REPORT OF SANITARY ENGINEER.

SAN FRANCISCO, January 4, 1896.

DR. MARTIN KELLOGG, *President of the University of California:*

DEAR SIR: Complying with your request, I have examined the drainage system of the several University buildings with a view to suggesting desirable repairs and alterations, and can now report as follows:

It seems superfluous to describe in detail the plumbing appliances connected with each of the several buildings, particularly as I am informed this has been thoroughly done by Mr. J. J. Sullivan, the plumbing inspector of the San Francisco Board of Health. But for the purpose of confirming and possibly in a few instances amplifying what he says in this connection, and to make the record of our examination complete, the following may be noted:

(The examination was made without cutting into walls or tearing up floors, and it may therefore be that in some instances traps or drain pipes have remained undiscovered.)

North Hall.—The ladies' closet is in fair order. It contains one Tidal Wave and two Golden Gate closets; one single and one triple washbasin. The pipe from the single basin is trapped; those from the others could not be seen. Location is such that absence of air-vents on the water traps is not a serious defect.

The water-closet under north steps on the west side of building is reserved for use of the instructors. There are four closets and four urinals in this water-closet, also a double washstand. The closets are in fairly good condition. There are no traps on washbasins and urinals. The closets are of the "Hydrostatic" pattern. They are fed with water direct from the water mains. A better arrangement would be to feed them from tanks. However, the closet pattern is a complicated one, not in general use, liable to get out of order, and difficult to repair.

There is a water-closet under south steps, west side of building, which is for use of the students. There are four compartments here, each closet being of the "Hydrostatic" pattern (for comments, see water-closets under north steps), and frequently out of repair. Along the west wall of the compartment are two wooden troughs, paraffine painted, serving as urinals A double washstand is between them. Water for flushing urinals is supplied continuously from small pipes along the wall. The flush is not thorough, and the arrangement is very liable to keep the floor of the compartment wet. There are no traps on the pipes from the urinals, nor on those from the washstands to the sewer. The drainage line for the floor is about 2 feet from the west wall of the compartment, an arrangement which is undesirable, as it puts the wettest portion of the floor directly under the feet of those using the urinals. There is also a water-closet just off from the President's office. The closet is of the "Desaco" type.

The washstands in the North Hall are all provided with traps, but only in the case of those in rooms 2, 9, 14, and 25, and in the President's office, are air-vents attached. There is, however, very little danger in the case of the others of a siphoning out of the water from their traps. Bad smells complained of sometimes (as in case of room 9 and the Janitor's room) may enter the room by way of the waste pipe from the drip-pans, under the washstands. (It was not apparent where these terminate. They should be let into the open air, not direct into a house drain.)

The sinks in the northern and southern third-story hallways have running traps in the drain pipes. There is no air-vent connected with these, but this defect is not serious.

On the east side of the North Hall are two surface-water inlets to the sewers; an air-vent and trap are connected with each, besides an inefficient bell trap attached to inlet cover. The surface water and the roof water might, in the case of this building, as well as in the case of all the others, where this is not already so arranged, be delivered either directly into the 18-inch iron-stone pipe draining the depression between the North Hall and the Mechanics and Electricity Building, or could be made to pass through one well-arranged trap so placed that there would be a certainty of its being supplied at all times with enough water to keep it sealed. Just south of the southwest flight of steps of this building an iron-stone pipe rises from the sewer. It is possible that this marks the position of a sewer-trap, but it is more likely that it is an inspection pipe. Its top was sealed. If intended for the latter purpose, it should be removed. If it is a trap, it is properly located to accomplish the purpose suggested in the recommendations for the sewer near the southwest corner of this building. Three of the principal leaders from the roof of this building pass through traps, two of which are connected with surface-water inlets. The two at the north end of the building and the one just south of the southwest steps are not trapped. The one from the porch on the west side of the building also seems to make an independent direct connection with the sewer lying along the west side of North Hall. As this pipe terminates at the upper porch at the elevation of the second story in the center of the building, it is extremely undesirable for use as a ventilating pipe for the sewer, and it should be led into the leader from the roof just south of the northwest flight of steps, or should be securely trapped in some other way.

Under the fire-hose reels throughout the building are drip-pans, from which waste pipes lead directly to the house-drain system. This is a very undesirable arrangement. The waste should be into the open air.

South Hall.—There is a water-closet under the front steps. The compartment in which this closet is placed is deficient in size, and more offensive to smell than any other examined. Two old pan-closets are in use. The double washstand at the north side of the compartment is provided with running traps in the waste pipe. The drain from the urinal trough, at the south side of the compartment, is without a trap.

The water-closet on first floor is reserved for the use of the Faculty. There is one washout closet ("Tay" pattern) and one old-style hopper closet in this compartment; also a double washstand and a urinal. Both closets receive water from tanks. The urinal is out of order. It should be removed immediately, either permanently or replaced by a modern fixture. There is a running trap in the drain pipe from the washstands. Vents from the closet drains are connected with the open air by means of a galvanized spiral pipe. The back vent of the Tay closet is closed by a plug. The attachments of the galvanized spiral pipe to the closet drains were concealed and could not be inspected. They may be defectively arranged.

The ladies' closet on second floor is directly above the water-closet on the first floor, and the arrangement of the washstand is similar. There is only one hopper-closet, supplied with water from a tank. A galvanized iron spiral vent-pipe connects closet drain with the vent-pipe rising from the water-closet on the lower floor.

The washstands in this building all seem to be reasonably well trapped. It does not appear that the lack of vents for the drain pipes from these basins is a serious defect, though it might become so, according to location and use of other fixtures.

The double washstand in room 37 has a small overflow drip from the drain into the drip-pan, which serves to feed the trap (supposed to be) on the waste pipe from this drip-pan to main drain pipe.

The sinks, so far as could be learned from inspection and inquiry, generally have traps on the drain pipes, even where none were apparent, as in the case of the desk sinks in the lecture-rooms; it is probable that there are running traps somewhere on the drain pipes before the sewer (which in this case lies below the concrete basement floor) is reached. This inference, made from the fact that the sinks do not become offensive, should not, however, prevent their being included among the fixtures to be remodeled whenever the plumbing system in this building is modernized.

Under the fire-hose reels in this building are drip-pans, from which the waste is direct to the sewer. This arrangement is seriously defective. A trap on the waste pipe would be inefficient, because it would not receive sufficient water to keep it sealed. The waste pipe should, as in the case of those from all drip-pans under water-closets and washstands, terminate in the open air.

The eight leaders for rain-water from the roof of this building are directly connected with the sewer, and serve to ventilate it. The objection to their use for this purpose, is that they terminate at the elevation of window sills of the upper or Mansard story.

Surface-water inlets to the sewers with imperfect bell traps, that are probably without water-seals, even when in good condition, more than one half the time are at the level of the basement on each side of the front and rear steps. It would be well to arrange for delivery of surface and roof water directly southward into Strawberry Creek.

Mechanics and Electricity Building.—This building has quite recently been completed. The plumbing throughout is modern and appliances are of standard types and in good order, except in the case of the water-closet on the second floor on the north side of the building. In the case of this closet it is to be noted that the rear vent was closed by a plug and has been broken, causing a slight overflow on to the closet floor every time the fixture is used. A closet in this portion of the building is said to be unnecessary.

The discharge from the closets in this building is into the sewer system of Berkeley through a 6-inch pipe leading northwesterly from the northwest corner of the building. An iron-stone pipe rising from this sewer about 100 feet from the building indicates a trap and fresh-air inlet at that point, but the air inlet is at present so snugly covered that it can hardly serve its purpose.

The discharge from all washbasins and from surface and roof drains in and about this building is not into the sewer, but into a separate system of drains, which lead directly into the 18-inch drain pipe in the depression to the south of the building, already referred to. The delivery of this large drain pipe is into the southern branch of Strawberry Creek.

Mining and Civil Engineering Building.—There is a water-closet on the third floor. This is the only water-closet in the building. It is not for general use. There is one old-fashioned pan-closet in this compartment, also a urinal and washstand. The water for the closet is taken direct from the pipes. Both the urinal and washstand are trapped, but without air-vents. The discharge from this closet is not into the general sewer system, but into the large drainpipe heretofore mentioned. At the time of my inspection of the creek at the mouth of the large pipe (December 31st) there was no evidence of any offensive recent flow from the large pipe. There is no reason why the delivery from this closet should not be into the sewer system, which can readily be reached by carrying the drain-pipe under the first-story floor to the southwest corner of the building.

Sinks and washstands in this building all drain into three lead pipes, which terminate in a 4-inch iron-stone trap under the building, near its northwest corner. There are no traps directly connected with the several fixtures, and, as there are a great many sinks in the rooms used by the Department of Mining, but little objection can be urged to a common trap for a number of these; but, whenever the plumbing is modernized, the traps used should be placed where they are readily accessible.

The sewers are directly connected with the leaders for rain water from the roof of the building, which afford ample opportunity for ventilation. The objection to their use is that they terminate below the windows of the fourth or Mansard story.

Chemical Laboratory.—The water-closets in this building are arranged on approved plans, the only criticism to be offered being as to size of drain-pipe used, which is an 8-inch iron-stone pipe. This is unnecessarily large.

The basins and sinks in this building are very numerous, and are nearly all intended to receive waste from chemical reactions. A system of iron-stone pipe drains has therefore been arranged independently of closet drains. These terminate in sumps outside of the building, with overflow pipes to the sewers; they are trapped in these sumps against a return flow of sewer gas. This system is simple and efficient.

Roof water is also delivered into these sumps, so that in the case of this building the leaders do not serve as vent-pipes.

Library.—In the water-closet under the north steps are two hopper-closets and a washstand. Water is supplied to the closets from overhead tanks. There is a trap on the drain-pipe from the washstand. There is no air-vent from these fixtures.

In the water-closet under the south steps are two hopper-closets, a urinal, and a washstand. The closets receive water from overhead tanks. There are traps on all fixtures, but no air-vents.

Roof water is led into the sewers direct, by the leaders—not through traps—thus making the leaders serve as sewer ventilators.

Gymnasium.—A water-closet, a washstand, and urinal are located on the first floor in the southwest corner of the building, and a washstand at the south wall. All these fixtures are in good condition, though vent-pipes are lacking.

There is a water-closet on the second floor, for use of ladies. This closet is of the offset type. It receives water from a tank. Its drain pipe is vented. The urinal in this water-closet should be removed.

Shower-bath drains all connect with sewers, and all are trapped. Roof water is in part at least delivered into the sewers without the intervention of traps, thus making the leaders ventilation pipes.

Agricultural Building.—Dry-earth closets are located in the southeast and southwest corners of the building. Only one of these is at present in use.

All washbasins and sinks are drained into the creek at the rear of the building.

THE SEWER SYSTEM.

The University buildings are very favorably situated for drainage. The fall available for the several lines of sewers is ample, and the matter of ultimate sewage disposal is of only secondary importance, because this question directly concerns the municipality of Berkeley, of which the University forms but a small part.

The delivery of sewage from the University grounds is into the Berkeley sewers. The alignment of sewers is shown on the topographical map in your Secretary's office.

The main sewer has a northwesterly course from the Mining and Civil Engineering Building in a direct line to the brick bridge across Strawberry Creek, opposite Dana Street. It crosses over the bridge. It is a 6-inch iron-stone pipe sewer, large enough for its purpose. Near the bridge it is too close to the surface of the ground, being barely covered by the macadam of the walk to the northeastward of the bridge. It is very much exposed to accident at this point, and should be better protected.

There are only two manholes on the sewer system of the University grounds. Manholes should be at intervals of about 400 feet along the several lines.

The flow in the sewers, when examined on December 23, 1895, was swift, and the sewers appeared free from offensive deposits. They were remarkably free from disagreeable odors.

No improvements of the main lines of sewers are immediately necessary; but on the branches from some of the principal buildings traps should be arranged, with vents to the air, so that a proper circulation of air in the house system of drain pipes will result, when properly vented fixtures are brought into use, and that the gas from the sewer will be kept entirely apart from the drain pipes within buildings.

The sewer gas itself may be led off from just below such traps by means of a pipe to convenient high points on the buildings.

RECOMMENDATIONS.

Based on the examination, the results of which are hereinabove set forth, it appears desirable to carry out improvements about as follows:

In *North Hall*, the water-closet under the northwest flight of steps, and that near the President's office, should be removed.

The water-closet under the southwest flight of steps should be used as a urinal only, possibly in a slightly changed location, and should be equipped with standard fixtures, having an automatic flush.

New closets should be established at convenient points in the building. There is room for these, with four seats each, at the west ends of the hallways, on the upper floors, if no more available space can be found. There should be at least one in each end of the building (if located in the hallway ends) for the students, and one reserved for the instructors.

Near the southwest corner of the building on the sewer (below old house connections) there should be an air-vent, a trap, and a sewer ventilating pipe, which latter should be carried to the top of the building.

The roof water and surface water from depressions adjacent to the building should be put into a separate system of drains leading to the 18-inch pipe, above referred to, in the depression north of the building.

All other fixtures in the building, including washstands, sinks, etc., where this is not already the case, should be equipped with modern appliances, properly vented, and all waste pipes from drips should terminate in the open air.

In *South Hall* the water-closet should be removed from under the front steps, and a new location should be found for a properly equipped closet and urinal.

In the closets on the first and second floors, the fixtures ought to be equipped with standard appliances, and the old-style fixtures should be replaced with new ones.

All washbasins, sinks, etc., should also be equipped with standard appliances, properly vented.

All waste pipes from drip-pans should terminate in the open air.

On each of the two sewers from this building to the main sewer, there should be an air-vent, a trap, and a ventilating pipe to the roof of the building, as suggested for North Hall (or according to selected location of the new closet); the use of one of the two sewer lines might be discontinued.

The roof water and surface water from depressions at the building should be put into a separate system of pipes and delivered southward into Strawberry Creek.

In the *Mining and Civil Engineering Building*, locations should be found for at least two water-closets. The east end of the building opposite the hallways would be an appropriate location for these closets. Urinals may be dispensed with if the seats are hinged. One of the closets should be reserved for the use of the instructors.

The discharge of the closets should be carried in a heavy cast-iron pipe to the sewer; not, as at present, to the 18-inch drain pipe.

There should be accessible traps on the drain pipes from the sinks and washstands, though it is by no means necessary to have one attached to each fixture.

The roof water should be delivered into a separate system of drain pipes and carried northward into the 18-inch pipe.

The usual air-vents and traps should be placed on the sewers from this building, at the northwest and southwest corners.

A water-closet should be established in the rear of the mill and the Civil Engineering Laboratory, with at least three compartments, of which one could be kept locked and reserved for use of the instructors. The vault now in use there, should be filled in when this closet is provided.

In the *Agricultural Building*, there should be a water-closet with urinals. At least four seats should be provided, of which one or two could be reserved for the use of instructors.

A branch sewer should be laid from this building to the main sewer.

The drain pipes from washstands, sinks, etc., should be provided with accessible traps. (It may be convenient to unite the drain pipes from several of these fixtures before trapping them.)

The discharge from these fixtures should be into the proposed branch sewer, to aid in keeping it clean.

Roof water should, as at present, go into the creek.

Near the building, on the proposed branch sewer, should be an air-vent, trap, and a ventilating pipe to the roof of the building.

In the *Mechanics and Electricity Building*, only the repairs as suggested in the general description, are necessary.

In the *Chemical Laboratory* all arrangements are good, but the system could be improved by placing an accessible air-vent and trap on the sewer near the building.

The floor of the main basement water-closet in this building should be covered with a thin asphalt pavement, having a slight slope to the surface drain.

In the *Library*, the closet fixtures should be replaced with others of standard patterns.

As the leaders from the roof are already connected with the sewer in such a way as to serve as unobjectionable ventilators, there seems to be no reason why their use for this purpose should be discontinued.

For the *Gymnasium* the removal of a urinal has already been suggested.

As the leaders from the roof are already connected with the sewer in such a way as to serve as unobjectionable ventilators, there is no good reason for discontinuing their use for this purpose.

At the *Astronomical Observatory*, a water-closet should be built with separate compartments for male and female students. A branch sewer should be laid from this to a connection with the sewer from the Mechanics and Electricity Building. When this is done, the vault to the west of the Observatory should be filled in.

There should be also *a closet* established *on the grounds* at some convenient point, probably near the Botanical Garden, for use of the laborers, and the branch sewer from this will probably have to be carried directly to a connection with the sewer in College Way.

IMPROVEMENTS TO BE MADE AT ONCE.

The following are suggested as improvements, to some extent of only temporary character, which should be made at once:

Traps should be put between the sewer and all the fixtures in the water-closets under the front steps of the South Hall; also, between sewer and those under both sets of steps of North Hall.

The leader from the front porch of North Hall should be connected with the leader at the south side of the northwest flight of steps, above the point where the latter is trapped.

An air-vent, trap (provided there is none at the supposed inspection pipe), and ventilating pipe to roof of North Hall, should at once be put on the sewer near the southwest corner of North Hall, below all leader connections.

The inspection pipe (if it be not connected with a trap) on the sewer south of the southwest flight of steps of North Hall, should be removed. If it is an air-inlet, it should be arranged to be kept open.

The urinal in the closet on the first floor of South Hall should be removed or replaced by a new one.

The waste-water pipes from the drip-pans under all fire-hose reels should be securely sealed. (Until such time as a proper arrangement is made for delivery of waste water into the open air, any small receiver will serve to receive the drip.)

The broken fixture in the closet on the second floor of the Mechanics and Electricity Building should be repaired.

A cast-iron drain pipe under the floor of the first story of the Civil Engineering and Mining Building should connect the closet drain with the sewer branch at the southwest corner of the building.

The urinal in the closet on the first floor of the Gymnasium should be removed.

On each of the two branch sewers from South Hall, an air-vent, trap, and ventilating pipe should be placed, and the ventilating pipes should be carried to the roof of the building.

The floors of both closets under the steps of North Hall should be repaired, and the surface-water inlets should be placed close to the west walls of the compartments.

The floors should have a slight pitch toward these, to facilitate the draining of the floors, which, where troughs are in use, are always liable to be wet and need frequent washing.

Respectfully submitted.

(Signed:) C. E. GRUNSKY,
Civil Engineer.

44. RESERVOIR.

Regent Houghton, on behalf of the Committee on Grounds and Buildings, submitted the following:

Your committee desires authority to expend not to exceed $100 in obtaining estimates of the cost of the proposed reservoir. [Granted January 14, 1896.]

45. Water in Strawberry Creek.

J. H. C. Bonté, Esq., *Secretary Board of Regents:*

Sir: Below I hand you a statement of the amount of water which flowed past the weir in Strawberry Creek (near South Hall) for the season 1895–96:

	Gallons.
1895—November	6,070,000
December	17,218,000
1896—January	45,522,000
February	7,556,000
March	4,264,000
April	20,469,000
May	6,494,000
June	889,000
Total	108,482,000

Very respectfully,

H. I. Randall.

July 1, 1896.

46. Macadamizing Oxford Street.

Regent Houghton, on behalf of the Committee on Grounds and Buildings, submitted the following offer made by J. J. Dunn for improving (grading, macadamizing, and curbing) a strip of land on the west side of the University grounds:

About 109 cubic yards grading, at 30 cents	$30 70
2,950 square feet macadam, at 6¾ cents	199 15
837 square feet gutter (grouted), at 9 cents	75 33
278 linear feet curbing, at 9 cents	25 02
Total	$330 20

Town Engineer's official fees donated by Town Engineer.

Mr. Dunn agrees to wait for his pay for the above work until the University is in funds.

On a call of the ayes and noes, the sum of $330 20 was appropriated to pay for the above-mentioned work. [January 14, 1896.]

47. Footpath from Center Street.

Regent Houghton submitted the following, on behalf of the Committee on Grounds and Buildings:

Resolved, That the Department of Civil Engineering be requested to formulate plans and specifications, with estimates of cost, for the construction of a gateway and roadway on the University grounds, from the proposed entrance on Oxford Street, at the head of Center Street, on a direct line to Strawberry Creek, and for the erection of a steel or stone bridge across said creek where it will connect with the present and form a continuous roadway to the University buildings;

Resolved, That the Finance Committee of this Board be and they are hereby requested to report at the next meeting of your honorable body what funds in the treasury of the University, not otherwise appropriated, are available for immediate expenditure for the improvement of the buildings and grounds of the University.

President Kellogg moved that a footpath 15 feet wide be made instead of a roadway 45 feet wide, in accordance with the plan submitted by Mr. McLaren, at a cost not to exceed $750. [Concurred in, on a call of the ayes and noes, January 14, 1896.]

48. Donation for Lighting the University Grounds.

Regent Houghton submitted the following communication:

Berkeley, January 13, 1896.

To the Honorable the Board of Regents of the University of California:

Gentlemen: The question of lighting the grounds of the University has been one of interest to citizens of Berkeley for many years. Hearing that Professor Cory, of the Electrical Department, has estimated the cost of poles, wire, and necessary adjuncts for such lighting, to be about $1,000, and realizing that there is no money in your treasury available for that purpose, the citizens of Berkeley have spontaneously responded to this need. On behalf of the citizens of Berkeley, I am, therefore, authorized to offer the sum of $1,000 to be used for the purpose of installation of electric lights on the University grounds.

If this offer is accepted, we trust that some of the lights will be placed in the dark spots among the trees and along the paths most frequented by those passing through. We do not make this a condition, but leave it to your sense of fairness and good judgment.

Yours respectfully,

J. W. RICHARDS.

Donation accepted, and the Secretary was instructed to make suitable acknowledgment. [January 14, 1896.]

49. Plan of Grounds.

Regent Reinstein moved that the Committee on Grounds and Buildings, together with the President of the University and the Academic Council, immediately consult with Mr. Maybeck, teacher of architectural drawing in the University, and prepare a programme for a general competition for a permanent comprehensive plan of the grounds and buildings of the University of California at Berkeley. [Adopted April 28, 1896.]

50. Matter for State Printing Office.

Regent Bartlett submitted the following from the Committee on Internal Administration:

At the last meeting of the Board, the following matter was referred to this committee: "To prevent delays in future in transmitting important documents to the State Printing Office, I move that the Committee on Internal Administration be requested to report to this Board a minute covering this point; and also indicating the kinds of material to be incorporated in the several documents transmitted for printing at the State Office."

Your committee submits the following minute, and recommends that it be adopted: "Hereafter, matter relating to State Printing shall be in the hands of the President, he consulting with this committee. When he has matter for the State Printer, he shall place the same in the hands of the Secretary, and the Secretary shall send the same to the State Printer, when approved and ordered by the President. The number of copies is to be determined by the Board." [Concurred in February 11, 1896.]

Regent Hallidie offered the following:

Whereas, The State Printing Office refuses to do such printing as is necessary for the legitimate purposes of the State University; and, believing that such refusal is not contemplated by law,

Resolved, That a proper presentation be made of the case by the Attorney of the Board, and an early decision by the courts be obtained thereon. [Adopted June 9, 1896.]

51. University Printing Office.

President Kellogg reported as follows:

The following proposal comes from the Recorder's Office, and I quite approve the adoption of the minutes prepared:

1. That printing ordered by the Board of Regents be done, so far as possible, by the University Press at Berkeley; but that, in case such printing, in the opinion of the President of the University, cannot be done by the Press without serious interference with its routine work, the President be empowered, upon consultation with the Finance Committee, to incur such additional expense for printing as may be necessary to comply with the orders of the Board.
2. That hereafter no work be done at the University Press except such as is of a strictly official character, and that the privileges heretofore extended to societies, classes, etc., be withdrawn until the facilities of the Press are increased. [Adopted June 9, 1896.]

52. Announcement of Courses.

President Kellogg reported as follows:

The annual Announcement of Courses is in the hands of the State Printer. The Board is asked to indorse the request for 2,500 copies of that pamphlet.

On motion, it was ordered that 2,500 copies of the Announcement of Courses be printed at the State Printing Office. [April 14, 1896.]

53. Reprint of Miss Shinn's Work.

Regent Bartlett, Chairman of the Committee on Library and Museum, submitted a request for the reprinting of 300 copies of the first part of Miss Shinn's work, at a cost of $38. The request is presented without recommendation from the committee.

President Kellogg moved that the sum of $38 be appropriated to pay for the above-mentioned printing. [Concurred in, on a call of the ayes and noes, October 8, 1895.]

54. DONATION OF RAISED MODEL SHOWING PLATEAU OF PACIFIC FROM VANCOUVER TO MEXICO.

President Kellogg submitted a communication from Professor George Davidson, offering for the acceptance of the Board, a raised model 6 feet square, showing the plateau of the Pacific from Vancouver Island to Mexico.

On motion, the gift was accepted, and the Secretary was directed to tender the thanks of the Board to Professor Davidson. [July 23, 1895.]

55. DONATION OF LUMBER FOR NEW BRIDGE.

BERKELEY, CAL., April 8, 1896.

DR. J. H. C. BONTÉ, *Secretary of the University of California, Berkeley, Cal.:*

DEAR SIR: Our bill, rendered February 28, 1896, for lumber used in the construction of the new bridge, amounting to $16 56, will be donated to the University, with best wishes.

Respectfully,

PACIFIC LUMBER COMPANY,
A. THAYER, Manager,
by Spires.

56. PREMIUM FROM MECHANICS' INSTITUTE.

SAN FRANCISCO, October 22, 1895.

J. H. C. BONTÉ, ESQ., *Secretary of the University of California, Berkeley, Cal.:*

DEAR SIR: At the late exposition of the Mechanics' Institute, a premium of $10 was awarded to the University of California, for display of decorative and industrial art. The same, I believe, was under the supervision of Professor Ardley.

I inclose you a check for the same, which please make such disposition of as you deem advisable.

Yours, very respectfully,

J. H. CULVER,
Secretary.

57. WILMERDING SCHOOL OF INDUSTRIAL ART.

Suggestions and Offers in re Site for Wilmerding School to be Submitted to the Board in Writing.—Regent Marye offered the following resolution:

Resolved, That all persons or bodies desiring to make to the Board any suggestion or offers relating to the selection of a site for the establishment of the Wilmerding School be notified and requested to communicate their views or propositions to the Board in writing, in order that they may be properly considered. [Adopted August 13, 1895.]

Donation of Check for $400,000 Framed.—The Secretary reported the following matter:

That Mr. Wm. Alvord had had the check of $400,000, by which the Regents had received the Wilmerding endowment, framed and had presented it to the University.

On motion of Regent Bartlett, the Secretary was directed to tender the thanks of the Board to Mr. Wm. Alvord, for his gift; also to the executors of the estate of the late J. Clute Wilmerding, and to E. J. McCutcheon, attorney for the said executors. [February 11, 1896.]

The Secretary submitted the following communication:

New York, February 5, 1896.

Wm. Alvord, Esq., *San Francisco:*

Dear Sir: Many thanks for the letters from Mr. Rowell and Mr. Bonté, relating to the cheque for the University of California. I am much interested in the success of the Wilmerding School of Industrial Arts, and am very glad to hear of anything in connection with it. A somewhat similar endowment was made by one of our family in Brunswick, Germany, although on a much smaller scale, more than a hundred years ago, and is still in existence. When the school is opened I hope to be present, if I can arrange to do so.

Again thanking you, believe me,

Very truly yours,

L. K. WILMERDING.

[On file February 11, 1896.]

Report of Special Committee on Site for Wilmerding School.

San Francisco, Cal., February 25, 1896.

To the Honorable Board of Regents of the University of California:

Gentlemen: Your Special Committee on Sites for Wilmerding School beg leave to report as follows:

The fund so generously bequeathed by the late Mr. Wilmerding of $400,000, it is generally admitted, should not be encroached on, either by the purchase of land or the erection of buildings, as its expected income of $24,000 per annum is but barely sufficient to keep up a first-class school, such as was intended by Mr. Wilmerding.

Though not formally advertised, wide publicity was given in the press to the nomination of this committee, and communications and tenders were invited to be addressed to its chairman. The result was numerous offers, as follows:

Hon. Adolph Sutro—property in San Francisco.
Citizens of San Leandro—property in San Leandro.
C. A. Hooper—property in Redwood City.
Castro Street Land Company—property in San Francisco.
James D. Phelan—property in San José.
F. K. Shattuck—property in Berkeley.
Hugh Dimond and A. C. Brandermuhl—property in Fruitvale.
F. A. Berlin—property in Oakland.
W. W. Judson—property in Oakland.
Citizens of Lakeport—property in Lake County.
Katie Dwyer—property in Lorin, Alameda County.
James Dunn—property in Alameda.
Thomas Badger—property in Oakland.
Louis N. Hager—property within one mile of Laundry Farm.
Shainwald, Buckbee & Co.—property in Alameda.
J. De Fremery—property in Oakland.
Regent Budd—sites in Sacramento and Stockton.

Seven were offers to donate a site free of cost. F. K. Shattuck, of Berkeley, offered five acres of land near the University, which has since been withdrawn.

J. D. Phelan, of this city, offered to donate a site in the City of San José, eight fifty-vara lots, or double that if necessary.

An offer of two blocks of land in Redwood City Addition, or ten acres in the Horace Hawes ranch.

Hon. Adolph Sutro offered as a site a large portion of Block 315 in the Western Addition, containing about three acres, with several conditions attached.

Citizens of San Leandro offered to donate a site in San Leandro.

Hugh Dimond and A. C. Brandermuhl offer five acres at the head of Fruitvale Avenue, Oakland.

A communication was received from the Merchants' Association of San Francisco. It states that the Castro Street Land Company offer to donate a site in the Mission District of the city.

The offer of F. K. Shattuck, having been withdrawn, need not be considered.

The second and third offers, that of James D. Phelan, land in San José, and that of C. A. Hooper, the land in Redwood City, were not favorably considered by your committee, as neither San José nor Redwood City were thought to be near enough to the center of population to be available.

The site offered by Mr. Sutro is thought to be too far out of town to ever become a successful competitor to the Lick and Cogswell Schools, which are supposed to offer the same advantage to poor boys to whom time and carfares must be an object.

Besides these tenders of donating a site, numerous tenders for the sale of a site have been made as far north as Lake County and as far south as San Diego County.

Inducements were held out, that citizens of the respective localities would make up purses to defray part or all of the expense of purchase.

Nearly all of these being too remote from San Francisco, have not been considered, except those from Oakland.

First—Block 487, bounded by Adeline, Seventh, Chestnut, and Fifth streets, 296 feet by 284 feet, containing nearly two acres, which can be purchased for $20,000, which sum, we are assured by a committee of Oakland business men, will be raised and the land donated for a site of the school.

Second—Seven acres of land in Temescal, half-way between Oakland and Berkeley, located between Telegraph Avenue and Shattuck Avenue and Garfield and Merced avenues, can be bought for $15,000, which has been raised by subscription and is available for the purchase. One advantage of this location is said to be that it is near enough to the University, so as to make it possible for the frequent attendance of its professors and teachers.

It is the opinion of your committee that either of above sites would answer the purpose, and a majority of the committee recommend the acceptance of the second offer in Temescal, on condition that a good and sufficient deed be tendered to the Board of Regents within three months free of cost and all incumbrances.

The preference of the committee is expressed with reference to the sites formally offered to it. The members of the committee reserve their liberty of judgment as to the advantages of other places where no sites were offered.

All of which is respectfully submitted.

Albert Miller, Chairman.
Columbus Bartlett.
J. West Martin.
A. S. Hallidie.
George T. Marye, Jr.

On motion, the report of the committee was ordered printed and a copy sent to each Regent, and that it be considered at a special meeting to be held five weeks from to-day, viz.: March 31, 1896. [February 25, 1896.]

Invitation to Appear before the Board.—Regent Black offered the following resolution:

Resolved, That the Secretary of the University send such portions of the Wilmerding will as apply to the object of the trust to the following gentlemen, and invite them to appear before the Board and furnish such information as they may deem valuable: President C. H. Keyes, Throop Polytechnic Institute, Pasadena; Prof. G. A. Merrill, Lick School, San Francisco; Prof. L. A. Buchanan, Cogswell School, San Francisco; Prof. W. N. Bush, Polytechnic High School, San Francisco. [Carried March 31, 1896.]

In response to the invitation, the above-named gentlemen appeared before the Board at a meeting held May 19, 1896. Their addresses are to be found in the Appendix.

Consideration of Wilmerding School Deferred. — Regent Reinstein moved that the meeting for the consideration of the Wilmerding School be postponed to May 19, 1896. [Carried April 14, 1896.]

Invitation to Appear before the Board.—On motion, it was ordered that the following-named gentlemen be invited to attend the meeting of the Board of Regents, to be held on the 19th of May, and express their views in regard to the Wilmerding School: Prof. H. T. Ardley, Hermann F. A. Schussler, Wm. Alvord, Thos. J. Lamb, and E. A. Fargo. [May 12, 1896.]

Professor Bush Requested to File a Paper Stating His Views.—Regent Black stated that Professor Bush, of the Polytechnic High School, who had been asked to address the Regents, was present at the meeting held May 19th, but that it was impossible for him to attend the present meeting, and moved that he be requested to file a paper stating his views, with the Secretary of the University, to be printed with the other papers. [Carried May 20, 1896.]

Consideration of Wilmerding School Laid Over Until November.—Regent Hallidie moved that the consideration of Wilmerding School matters be laid over until the regular meeting of the Board, to be held in November, 1896. [Carried June 9, 1896.]

58. Affiliated Colleges Buildings.

Purchase of Site for Affiliated Colleges Buildings.—Regent Marye moved that Dr. R. Beverley Cole be allowed to present certain communications in relation to the buildings for the Affiliated Colleges of the University. [Concurred in.]

Dr. Cole then submitted the following:

San Francisco, July 20, 1895.

To the Honorable Board of Regents of the University of California:

Gentlemen: In pursuance of instructions received from the Joint Committee on Site and Building of the Professional Departments of the University, I beg to ask that your honorable body appoint a committee to confer with a sub-committee to which has been assigned the duty of devising ways and means by which a sufficient sum of money may be obtained for the purpose of purchasing the necessary land for the building to be erected for the affiliated departments of the University.

The joint committee further hopes that your honorable body will indorse the inclosed application to the Board of State Prison Directors.

I have the honor to be,
Your obedient servant,
A. A. D'ANCONA,
Secretary of Joint Committee on Site and Building of the Professional Departments of University of California.

San Francisco, July 20, 1895.

To the Honorable Board of State Prison Directors:

Gentlemen: By authority of the Board of Regents of the University of California and of the Joint Committee on Site and Building of the Professional Departments of said University, the undersigned respectfully request that your honorable body accord the privilege of procuring the necessary dimension granite, both rough and dressed, at cost of tools and machinery, for the building to be erected for the Affiliated Colleges of the University.

We have the honor to be,
Respectfully yours,
(Signed:) CHARLES W. SLACK.
W. F. McNUTT.
CHARLES E. BROWN.
R. BEVERLEY COLE.

Regent Houghton offered the following resolution:

Resolved, That the President and Secretary of the Board of Regents be and they hereby are authorized and instructed to sign the foregoing communication to the honorable Board of State Prison Directors, and to transmit the same to the said honorable Board of Directors. [Adopted July 23, 1895.]

The Chair appointed as special committee to confer with a sub-committee to which has been assigned the duty of devising ways and means by which a sufficient sum of money may be obtained for the purpose of purchasing the necessary land for the buildings to be erected for the affiliated departments of the University, Regents Crocker, Houghton, and Miller. [July 23, 1895.]

Proceedings of the Board, September 10, 1895, in re Site for Affiliated Colleges.—Dr. Cole, on behalf of the Committee of the Affiliated Colleges, submitted the following report, and addressed the Board:

San Francisco, September 9, 1895.

To the Honorable Board of Regents of the University of California:

Gentlemen: "The Hastings College of the Law, the Medical College, the College of Dentistry, the College of Pharmacy," named in the Act of March 23, 1895, through their respective committees duly appointed for the purpose, and acting in conjunction with your committee, consisting of Regents Houghton, Hallidie, Phelps, and Marye, have visited and examined the several locations submitted to them as appropriate places from which to select a site for the buildings provided for in said Act.

Said colleges, as colleges, have unanimously agreed upon and selected the site, consisting of thirteen acres situated on J Street, on the south side of Golden Gate Park, and offered to the Regents by the Hon. Adolph Sutro as a free gift for the purposes indicated in the Act, as in all respects the most desirable that has been called to their attention.

The reasons inducing this selection are apparent and numerous, and the undersigned, a sub-committee appointed for that purpose, are present at the request of the General Committee, and are prepared, should it be your desire, to give the reasons why the foregoing selection has been made.

Respectfully submitted.

R. BEVERLY COLE.
OLIVER P. EVANS.
F. A. BECKETT.
L. L. DUNBAR.

The Secretary submitted a protest, signed by W. F. McNutt and W. E. Taylor, and read the same to the Board.

Dr. Cole replied to the protest.

Regent Hallidie to Mr. Sutro: "When do you expect to complete the Library building?"

Mr. Sutro: "I expect to begin the work in a couple of years, and to complete it in five years."

Regent Hallidie: "If the Library building is to be located near the Affiliated Colleges buildings, that fact will influence my vote."

Mr. Sutro: "I will obligate myself to complete the Library building inside of five years."

Regent Foote: "Do you intend to transfer the land and library to trustees?"

Mr. Sutro: "Yes; in ninety days."

Regent Crocker: "In your deed to the Regents, do you intend to insert any restrictions?"

Mr. Sutro: "Only that the property be used for University purposes."

Dr. Cole then submitted the following letter from Mr. Sutro:

Dr. Beverly Cole, *President of Committee on Site for the Affiliated Colleges:*

Dear Sir: I hereby confirm the offer made to the Committee on Site for the Affiliated Colleges in my several letters, dated July 24th, July 30th, August 9th, August 14th, and one addressed to Mr. Beckett.

Respectfully submitted.

ADOLPH SUTRO.

September 10, 1895.

Regent Rodgers offered the following:

Resolved, That the Chairman of the Law Committee, Regent W. T. Wallace; the Chairman of the Committee on Grounds and Buildings, Regent J. West Martin, and the Chairman of the Finance Committee, Regent A. S. Hallidie, be appointed a special committee to formulate and report more definitely that which has been said orally to-day.

The resolution was adopted.

Mr. Sutro said that he would be pleased to have the question of acceptance disposed of at that time. It was said, in reply, that the Board was ready to accept the Sutro site, and that formal acceptance must be delayed until the receipt of the report of the special committee.

Regent Rodgers moved that when the Board adjourns, it adjourn to meet Tuesday, two weeks from to-day, September 24, 1895, at 1:30 P. M. [Carried September 10, 1895.]

Report of Special Committee in re Offer of Site by the Hon. Adolph Sutro.—Regent Wallace submitted the report of the special committee, as follows:

The undersigned special committee, to whom was referred the matter of the offer of the Hon. Adolph Sutro of a site for the Affiliated Colleges, beg to report as follows:

The consideration of the matter referred to your committee has been delayed through the sickness of the chairman of the committee.

Repeated interviews have been held with Mr. Sutro, who has at all times exhibited great diligence and readiness in attempting to formulate and complete the plan by which a site for the Affiliated Colleges of the University is to be provided.

The terms of his proposed conveyance, to be made to the Board, have been fixed upon between him and the committee. A draft thereof is herewith submitted. It contains the substance of the understanding had between the donor and the Regents as to the basis of the donation. It is his purpose to proceed to the erection of the proper Library building upon the adjoining tract of land. The methods which he proposes to pursue with reference to the Library and Library building are those that have been heretofore communicated to the Regents.

Mr. Sutro repeated to the committee his purpose to comply with each and every proposition heretofore submitted by him to the Board concerning the erection, organization, and maintenance of the proposed library, as well as that portion of his proposal which directly affects the site of the Affiliated Colleges—embracing the sand-leveling of the College site, the sewering with 12-inch iron-stone sewers, and the macadamizing of J Street from Sullivan Street westerly to Fourth Avenue, with a 6-inch layer of rock taken from the Library or College site or from the widening or grading of J Street.

The committee is satisfied that he has a purpose to proceed with all convenient speed to the performance of all promises made by him, and in addition to making this magnificent donation of this College site, is actuated by a sincere desire to erect and maintain, in the most efficient manner, upon the adjoining tract of land, a library, the contents and appointments of which will be inferior to none in the United States.

Form of Conveyance.

This Indenture, made and entered into on this the 8th day of October, in the year of our Lord one thousand eight hundred and ninety-five, between Adolph Sutro, of the City and County of San Francisco, State of California, party of the first part, and the Regents of the University of California, party of the second part,

Witnesseth: Whereas, an Act entitled "An Act appropriating two hundred and fifty thousand dollars for the erection of buildings for the use of affiliated and other departments of the University of California," was duly passed by the Legislature of the State of California, and approved on the twenty-third day of March, 1895, by the Governor, which said Act is in words and figures following, to wit:

"The People of the State of California, represented in Senate and Assembly, do enact as follows:

"Section 1. The sum of two hundred and fifty thousand dollars is hereby appropriated out of any money in the State Treasury not otherwise appropriated, to be paid to the Regents of the University of California, to be expended by them in the erection of buildings grouped together on such site in San Francisco as the Regents may select, for the use of the professional and affiliated colleges, to wit: The Hastings College of Law, the Medical Department, the College of Dentistry, the College of Pharmacy, the Biological Laboratory, University Extension Lectures, and other departments of the University of California conducted in San Francisco. And the Controller of State is hereby authorized and directed to draw his warrants for said sum at such times and in such partial payments as he may be requested by said Regents of the University of California, and the Treasurer of the State is hereby directed to pay the same; provided, however, that one half of said sum of two hundred and fifty thousand dollars shall be expended during the forty-seventh fiscal year, and the other half during the forty-eighth fiscal year.

"Section 2. This Act shall take effect and be in force from and after its passage."

And whereas, Adolph Sutro, party of the first part hereto, has offered to the Regents of the University of California, as a site for the erection of buildings to be grouped together thereon in compliance with and for the purposes mentioned in said Act, and to be held by the said Regents of the University of California under certain conditions—five in number—hereinafter mentioned, all that certain piece or parcel of land, situate, lying, and being in the said City and County of San Francisco, State of California, particularly described as follows, to wit:

Commencing at the southeast corner of Fourth Avenue and J Street; thence along the south line of J Street north 70° 19′ east, eight hundred and ninety-six feet seven and one half inches (896′ 7½″) to a point on the west line of First Avenue, if the same were continued in a southerly direction; thence south 3° 15′ east, being a line in continuation of the west line of First Avenue, seven hundred and eighty-seven feet six inches (787′ 6″); thence at right angles south 86° 45′ west, eight hundred and sixty feet (860′) to the east line of Fourth Avenue; thence at right angles and following along the east line of Fourth Avenue, five hundred and thirty-three feet ten inches (533′ 10″) to the point of commencement. Containing an area of thirteen and forty-three thousandths (13.043) acres; the said land aforesaid being herein referred to as the "Affiliated College site."

And the said the Regents of the University of California, party of the second part hereto, have duly accepted and do hereby duly accept the said offer of the said Adolph Sutro, party of the first part, with the said conditions hereto annexed, as aforesaid in that behalf.

The conditions aforementioned, and to the observance of which conditions, and each and every one thereof, the said the Regents of the University of California, party of the second part, hereby and by their acceptance of this indenture bind themselves, are as follows, to wit:

First—That said Affiliated College site is to be devoted exclusively to the use and benefit of the Affiliated Colleges of the University of California, and no building shall be placed thereon which is not necessary or appropriate for collegiate purposes.

Second—That all buildings and structures erected thereon shall be, as far as practicable, fire-proof as against fire arising internally or externally, and no dwelling or residence shall be placed on said Affiliated College site, except a building for the use and residence of the janitors, which building shall be, as far as practicable, fire-proof, and so far removed from the other buildings as to reduce the danger of a fire therefrom to a minimum.

Third—That no building erected on the said Affiliated College site shall be nearer than twenty-five feet to the southerly prolongation of the westerly line of First Avenue.

Fourth—That the College buildings must be erected on said Affiliated College Site, and said Affiliated College site and buildings must be used solely for the purposes of Affiliated Colleges of the University of California.

Fifth—That work on said buildings mentioned in said Act of the Legislature, must be commenced by the party of the second part within six months from the date of these presents, and said College buildings, to the extent of the appropriation heretofore made therefor by said Act, must be completed within five years from the commencement of the work.

And the said the Regents of the University of California, party of the second part, having duly accepted the said offer of said Adolph Sutro, party of the first part, subject to each and every of the conditions hereinbefore expressed:

Now, therefore, the said Adolph Sutro, party of the first part aforesaid, in consideration of the agreement and promise of the said the Regents of the University of California, party of the second part, to erect the said buildings for said collegiate purposes, and to faithfully keep and observe all and singular the conditions hereinbefore enumerated and set forth, has granted, sold, and conveyed, and does by these presents, grant, sell, convey, and confirm unto the said party of the second part, the Regents of the University of California, the land and premises hereinbefore particularly described, containing the area of thirteen and forty-three thousandths acres of land, together with all and singular the tenements, hereditaments, and appurtenances thereunto belonging or in any wise appertaining; to have and to hold all and singular the said premises, together with the appurtenances, unto the said party of the second part and their successors forever, subject to the conditions aforesaid; but for breach upon the part of the party of the second part of any of said conditions, the title to the said land hereinbefore described shall revert to and vest in the said party of the first part, his heirs and assigns.

In testimony whereof, the said party of the first part has hereunto set his hand and seal at the City and County of San Francisco, State of California, the day and year first in this indenture above written.

Signed, sealed, and delivered, in the presence of ——.

The committee begs to submit a resolution that the Indenture of Conveyance proposed by Mr. Sutro and now submitted to the Board be accepted, and that the Secretary be instructed to address a letter to the donor, expressing the thanks of the Board for the munificent donation he has made, and congratulating him upon the fact that the Affiliated

Colleges and the Library will stand as enduring monuments for all time, reminding their beneficiaries of his public spirit and generosity.

The resolution was adopted, on a call of the ayes and noes. [October 8, 1895.]

In accordance with the resolution of the Board, I addressed the following letter to Hon. Adolph Sutro:

BERKELEY, October 12, 1895.

To the HON. ADOLPH SUTRO:

DEAR SIR: I am instructed by the Board of Regents of the University of California to convey to you their thanks "for the munificent donation you have made to the University of California, and to congratulate you upon the fact that the Affiliated Colleges and the Sutro Library will stand as enduring monuments for all time, reminding their beneficiaries of your public spirit and generosity."

The intrinsic value of your munificent donation, great as it is, is exceeded by its timeliness and practical usefulness. The University is now crippled by its rapid growth; it is unable adequately to provide room and instruction for its undergraduates; it is painfully restricted in its efforts to strengthen its post-graduate department and affiliated colleges. Your timely gift will enable the Regents to use a large sum of money donated by the State, and both together will give a place to work in, while the Sutro Library will add acceptable and necessary instrumentalities that will impart momentum to the minds, the lives of thousands of students.

Already we see the fruit—in the renewal of courage, in the hopefulness, of those who have been discouraged by our restrictions, creating a widespread willingness to make personal sacrifices for the good of the great cause, placing the University "in the very focus of public observation."

The Regents and the University thank you most cordially for a gift so timely and effective for good. They also congratulate you upon the fact that the Affiliated Colleges and the Sutro Library, the former an integral part of the University, and the latter a practical adjunct, will stand as enduring monuments, for all time, of your public spirit and generosity. Centuries ago, universities, having the only accessible libraries, were made great by their books as much as by their teachers, sometimes gathering together thirty thousand students at a single institution. The art of printing made books more abundant and accessible, and the number of students attending universities diminished. Since then the number of valuable printed books has increased immensely, and now good books are so exceedingly numerous that no student can gather the books that he needs—hence, as of old, and for the same reason, he must needs search for the needed literature in the larger libraries, among the largest of which will be the Sutro Library. We have reason, therefore, to expect the age of large attendance at universities and their associated libraries, reaching, doubtless, once more into the tens of thousands.

It is, therefore, reasonable to expect, as formerly, that the great universities will again become the all-comprehensive centers of the higher learning that makes humanity great, the home of those devoted to the use and preservation of books, thus assuring perpetuity to great libraries. You, sir, may rightfully enjoy the well-founded and cheering belief that the Sutro Library, being so intimately connected with the University of California, will be so protected and preserved by the safeguards developed only in universities.

The history of universities and great libraries also shows a degree of cohesiveness and continuity unknown in other human enterprises. States and empires are revolutionized; great upheavals destroy them; but institutions of learning, which are ever dominated by the fundamental principles which lie at the very basis of the structure of the human mind, continue through the ages. They may, with their flexibility and their power of adaptation, grow or shrink as the exigent needs of man may require, but the real continuity of their life never ceases. Institutions of learning, universities, alone, continue—they seem to be imperishable, immortal, and they hand down to the ages as they come all that is good and great of the past.

Honored sir, the Board of Regents and the University of California can safely congratulate you upon the fact that "the Affiliated Colleges and the Sutro Library will stand as enduring monuments for all time, reminding their beneficiaries of your public spirit and generosity."

I have the honor to subscribe myself, with great respect,
Your obedient servant,

J. H. C. BONTÉ,
Secretary of the Board of Regents.

Committee on Grounds and Buildings to Prepare Plans and Specifications.—Regent Bartlett offered the following resolution:

Resolved, That the Committee on Grounds and Buildings, including Regent Phelps, be directed to prepare plans and specifications for the buildings of the Affiliated Colleges, to be submitted to this Board, and to act in conjunction with a committee of one from each of the Affiliated Colleges. [Adopted October 8, 1895.]

Attorney of Board to File Opinion as to Title of Site Donated by Hon. Adolph Sutro.—Regent Houghton moved that the Attorney of the Board be requested to file an opinion as to the title to the site for the Affiliated Colleges buildings, donated by Hon. Adolph Sutro; also, as to incumbrances thereon, if any. [Carried November 12, 1895.]

Any Obligation Subject to Clear Title.—Regent Reinstein moved that any obligation entered into be subject to the receipt by the Regents of a clear title to the property, free from all incumbrances. [Carried November 12, 1895.]

Attorney of Board to Prepare Instrument that Will Bind Mr. Sutro in his Promises.—Regent Wallace moved that the Attorney of the Board prepare an instrument that will bind Mr. Sutro in his promises in relation to the Library and Library building, as well as the Regents. [Carried November 12, 1895.]

Regent Reinstein moved that in addition the Attorney indicate to Mr. Sutro that the proposition is not lack of confidence in him. [Carried November 12, 1895.]

Attorney of Board to Obtain Opinion from Attorney-General in re Act of 1895.—Regent Marye offered the following resolution:

Resolved, That the Attorney of the Board be instructed to procure from the Attorney-General of the State an opinion as to the construction of the Act of 1895, appropriating money for the erection of buildings for the Affiliated Colleges, including the grouping of buildings; also, as to whether it will be necessary to advertise for plans and specifications, or whether the sum of $125,000 must be expended during the current fiscal year. [Adopted November 12, 1895.]

Opinion of Attorney-General in re Affiliated Colleges Act.

San Francisco, November 29, 1895.

Board of Regents of the State University, Berkeley, Cal.:

Gentlemen: In reply to your request for a construction of the Act entitled "An Act appropriating $250,000 for the erection of buildings for the use of affiliated and other departments of the University of California," approved March 23, 1895 (Stats. 1895, pp. 69–70), in the following particulars: (1) As to whether the Act requires more than one building to be erected, and if so, how many; or whether it is discretionary with the Regents to erect one or more than one building; (2) Whether or not it is required by the Act that $125,000 of the appropriation should be expended and drawn from the treasury during the present fiscal year; and, (3) As to whether or not an Act entitled "An Act to regulate the erection of public buildings and structures," approved April 1, 1872 (Stats. 1871–72, p. 925), applies to the University buildings provided for in the Act of 1895.

1. I am of the opinion that the Affiliated Colleges Act of March 23, 1895, contemplates the erection of a number of buildings grouped together, and that it was the intention of the Legislature that a building for each of the departments of the University of California which are enumerated in the Act, and such other departments as are now conducted in San Francisco, should be erected, and that all of such buildings should be grouped together upon one site, and not scattered throughout the city upon various sites. It has always been the policy of our laws concerning the State University that "separate buildings for separate uses" should be provided. (See Section 1437, Political Code.)

2. I am further of the opinion that the express provision of the Act, viz.: "That one half of said sum of $250,000 shall be expended during the forty-seventh fiscal year," must be strictly obeyed. The language is mandatory and unequivocal.

3. I am also of the opinion that whenever the Legislature provides for the erection of public buildings by any person, board, or committee, such buildings must be erected in accordance with and under the general laws of the State relative to public buildings, unless the Act providing for their erection expressly and in terms exempts them from the operation of such building laws. There is no such exemption contained in the Affiliated Colleges Act, and although the Act provides for the payment of the appropri-

ation to the Regents of the University of California "at such times and in such partial payments as may be requested by said Regents," it also provides that such money is "to be expended by them in the erection of buildings grouped together on such site in San Francisco as the Regents may select," specifying the uses to which these buildings are to be put. Therefore, it was the evident intention that the money so appropriated should be expended by the Regents in the manner provided by law for the expenditure of money in erecting public buildings, and not arbitrarily and without regard to the salutary provisions of the laws of the State regulating the erection of such buildings.

Respectfully,

W. F. FITZGERALD,
Attorney-General.

Attorney of Board to Begin Proceedings Requiring the State to Pay $125,000 to the Regents.—Regent Hallidie offered the following:

It is the opinion of the Counsel of the Board that the Board of Regents can, upon a mandamus, require the payment of $125,000 of the amount appropriated by the Legislature of 1895, by an Act approved March 23, 1895, for the erection of buildings for the Affiliated Colleges.

Resolved, That J. B. Mhoon, Counsel of the Board of Regents, be and is hereby authorized to begin proceedings requiring the State to pay $125,000 into the hands of the Treasurer of the University of California. [Adopted December 10, 1895.]

Three Buildings to be Constructed for the Affiliated Colleges.—Regent Hallidie offered the following resolution:

Resolved, That it is the opinion of this Board that the Regents shall construct four buildings for the Affiliated Colleges, as enumerated in the Act for the erection of buildings for the Affiliated Colleges.

Regent Bartlett moved to amend by striking out the word "four" and inserting in place thereof the word "three"; also, by striking out the words "as enumerated in the Act." [Concurred in, on a call of the ayes and noes.]

The resolution as amended was then adopted.

Ordered also that plans and specifications be advertised for. [December 10, 1895.]

Communication from Governor James H. Budd.—Regent Phelps submitted the following communication from the Governor of the State and ex officio President of the Board of Regents:

December 26, 1895.

J. H. C. Bonté, Esq., *Secretary Board of Regents, Berkeley, Cal.:*

Sir: A few days ago I received from John B. Mhoon, Attorney for the Regents, a communication requesting me to order the Controller to issue his warrant for one half of the Affiliated Colleges appropriation, in order that friendly court proceedings might be had to determine the right of said Regents to withdraw the entire appropriation for each fiscal year in like manner. Accompanying Mr. Mhoon's letter was your certified copy of the following resolution of the Board of Regents:

"Resolved, That the President of the Board is directed to draw from the State Treasury, upon an order drawn upon the State Controller for a warrant on the State Treasurer, in favor of the Treasurer of the University of California, at any time during each fiscal year ending June 30, any or all moneys appropriated by the Legislature of the State of California, for the uses of the Regents of the University of California for the forty-seventh and forty-eighth fiscal years, under an Act entitled 'An Act appropriating $250,000 for the erection of buildings for the use of affiliated and other departments of the University of California,' approved March 23, 1895.

"Adopted.

"The Controller of the State of California is hereby requested to draw his warrant in favor of the Regents of the University of California for the sum of $125,000, the same being the partial payment due on the request of said Regents of the University for the forty-seventh fiscal year, pursuant to the provisions of the Act of the State Legislature mentioned in the within resolution of said Regents, and the Treasurer of the State of California is directed to pay over said sum, to wit, $125,000, to the Regents of the University of California.

"———— ————,
Governor, and ex officio President of the Board of Regents."

It is true, as Mr. Mhoon says, that the Supreme Court in *Lundy* vs. *Delmas*, decided that the State Constitution abrogated provisions of law in conflict with the Organic Act of 1868. The portion of Act of 1867-68 involved, read: "All moneys which may at any time be in the State Treasury, and subject to the use of said Board of Regents, may be drawn therefrom for the purpose of the Board, upon the order of said Board, in favor of the Treasurer of the University."

The Act of 1895, however, says: "The Controller is authorized and directed to draw his warrants for said sum at such times, and in such 'partial payments,' as he may be requested by said Regents of the University of California, and the Treasurer of the State is hereby directed to pay the same"—that is, pay the warrants of the Controller of the State, which can only be drawn for such "partial payments," as are needed in the construction of said buildings. This was specially required as a condition of the appropriation. The reason for the change was that the building might be constructed by the Regents under the provisions of the Act of 1876, and not otherwise. When the statute of the State says that the Controller is authorized to draw his warrants for "partial payments" requested by the Regents of the University, it does not contemplate the withdrawal in bulk of all the money available during each fiscal year, for the purpose of transferring it from the State Treasury to the treasury of the University of California.

Until the plans and specifications are adopted, and the contract is made and filed with the Controller, there can be no compliance with the law by an order, as requested. The warrants must be in payments, and for payments, and not in contemplation of future payments under a future contract.

I do not consider it an expenditure of money to simply change the custodian thereof.

I am further constrained to the position I take, as the Regents have made no special request for an order for this amount.

I was present at a meeting of the Regents, subsequent to the passage of the resolution in question, and it appeared then to be their impression that the building should be constructed under the Act of 1876. It was stated, however, by some of the Regents, and by other gentlemen present, that should the funds be insufficient to construct the buildings, a further appropriation would be asked. You will recall my insisting that I would not approve the plans or specifications for the construction of said buildings until it was clearly shown that the amount of the appropriation would not be exceeded. The history of the construction of many public buildings of the State shows that the first appropriation of the Legislature is seldom sufficient; that the persons in charge, in love for their special institution, have applied and re-applied to the State for further assistance, until the contemplated cost seldom equals half of its real cost. I am determined that such shall not be the case in the construction of the building in question, and I am certain the Regents will sustain me in this determination. The Legislature appropriated all that was asked—$250,000; and, as Governor of the State, I will deal with the institution (although my Alma Mater) so that no deficiency is created.

While I regret the delay in adopting the plans and specifications and the possible lapsing of any moneys appropriated, I am compelled, in justice to myself, and in justice to the institution itself, to take the stand I do. I am willing to assist in any test case made, as to how the plans and specifications are to be drawn, and how the buildings are to be constructed, but I will not, unless compelled by the Supreme Court, consent that this money shall be drawn from the State Treasury until these plans are approved by the Secretary of State, Hon. L. H. Brown, by the State Treasurer, Hon. L. Rackliffe, and by myself.

I would urge the Regents to determine the question of plans and specifications immediately, and it may be that under the contract entered into the $125,000 can be expended during the forty-seventh fiscal year. If not, any money covered into the State Treasury can be re-appropriated by the next Legislature.

Yours truly,

JAMES H. BUDD,

Governor, and ex officio President of the Board of Regents.

[Received and ordered on file January 14, 1896.]

Report of Committee on Grounds and Buildings in re Advertising for Plans.—Regent Houghton, on behalf of the Committee on Grounds and Buildings, submitted the following:

At the last meeting of your honorable body, the Affiliated Colleges being under discussion, the question of the adoption of preliminary proceedings was referred to the Committee on Grounds and Buildings, and Regent Phelps was added as a special member, to advertise for plans and specifications for the erection of three separate structures for the use of the Affiliated Colleges in San Francisco, in conformity with the opinion of the Attorney-General.

Your committee placed the matter in the hands of the Counsel of the Board, who prepared the first published notice calling for plans, the committee offering a premium of $500 for the plan which should finally be adopted as the most satisfactory. After the publication of the notice, it became apparent to your committee that something more than the general notice given was necessary, and the time designated for the submission was too short. Under this impression, the Chairman of the Building Committee called a meeting of the Committee on Grounds and Buildings, the Committee of the Affiliated Colleges, and others, for the consideration of pertinent business, to wit:

1. Extension of time to architects to furnish plans, from January 17, 1896, to January 31, 1896;

2. For the submission of any information in the possession of the Regents, or under their control, that would assist the contesting architects in the preparation of plans;

3. The approval of the offer of a premium of $500 for the most satisfactory plan.

Your committee herewith report progress and for approval of above changes in the proceedings and the offer of a premium. [Approved January 14, 1896.]

Report of Committee on Grounds and Buildings in re Plans.—Regent Martin submitted the report of the Committee on Grounds and Buildings, as follows:

The Committee on Grounds and Buildings reported, at the last meeting of your honorable body, progress in the matter of the Affiliated Colleges buildings plans, to wit:

That the committee had advertised for plans, had extended the time for the reception of plans, and had offered a premium for the plan that should finally be adopted by your honorable body.

In conformity with the extended time appointed for the presentation of plans (January 31st), your committee, with the representatives of the Affiliated Colleges and the architects of the respective plans, met in the South College, in the Secretary's office at Berkeley, where five plans were received and exposed to view, to wit: Plans of William Curlett, Krafft, Martens & Co., McDougall & Son, Mr. Pelton, and Mr. Albert Sutton. After consultation it was deemed best to remove the plans to the Regents' room in the Art Association building in San Francisco, where they would be more accessible to all parties interested for inspection and examination. The committee then adjourned to meet at the Regents' rooms on Tuesday, the 4th day of February, for the purpose of interviewing the representatives of the Affiliated Colleges as to the best design for their several purposes, and also the architects as to their plans, estimates of construction, their adaptability, the manner and material of construction, and the provisions for general utility.

The Committee of the Affiliated Colleges widely differing in their views as to the merits of the different plans with regard to the several departments, and the committee believing that there would be no unity of opinion arrived at by them, so as to concentrate all opinions and energies upon the object in view, of erecting the Affiliated Colleges buildings within the appropriation and within the time appointed by the Act of the Legislature, the committee, after thorough investigation of all pertinent matters presented, and in consideration of the diversity of opinions prevailing, deemed it best for all parties, in order to have an early and satisfactory determination of the matter, to appoint a commission of architects of high professional ability and unquestionable integrity, to make careful estimates of the plans and their adaptability, the character of construction, etc. The said commission will advise your honorable body through your committee as to the wisest and most proper course to pursue in the adoption of the final plan.

Your committee in session adopted a motion to pay the commission the sum of $500, to be apportioned equally between them. The commission will consist of the following gentlemen, unanimously chosen, to wit: Albert Pissis, of San Francisco; Clinton Day, of Berkeley, and Walter J. Mathews, of Oakland. All proceedings subject to the approval of your honorable body.

The committee then adjourned to meet in the Regents' rooms on Saturday, February 8th, for further consultation upon the same subject.

In conformity with the above, your committee convened, pursuant to notice, on Saturday, the 8th day of February, in the Regents' rooms in the Art Association building; the commission of architects being present, ready, in response to the request of the Regents, with reference to the proposed examination of plans. It was hoped your committee could be able to report something definite for to-day's meeting; the commission, however, will not report until they have made a thorough examination of all the plans, the estimates, material of construction, etc., which will consume most of the present week, so that upon Tuesday, February 18th, at farthest, or at an earlier date if possible, your committee will submit a report with definite plans, the report of the commission, etc., for your consideration at a special meeting to be convened for that purpose.

Your committee submits this report in the line of their proceedings—to this date—for the approval of your honorable body.

Regent Bartlett moved that the action of the committee be approved, and when the Board adjourns, it adjourn to February 19, 1896, at 1:30 P. M. [Concurred in, on a call of the ayes and noes, February 11, 1896.]

Report of Commission of Architects.—Regent Martin submitted the report of the commission of architects, as follows:

San Francisco, February 17, 1896.

To the Building Committee of the Board of Regents of the University of California:

Dear Sirs: In response to your request, we herewith submit our report on the designs furnished by the different architects in answer to your call for competitive drawings and specifications for the buildings of the Affiliated Colleges of the University of California. We have endeavored to come to a definite conclusion in as short a period of time as possible, being fully aware of the necessities imposed by the Act of the Legislature. It is a source of regret that more time could not have been given to the competing architects, as the list of requirements of the proposed buildings is very complex and calls for much more than could be expected, in a substantial form, for the money appropriated. The different designs show evident haste and lack of time for their production, notwithstanding a great amount of labor has been expended upon them.

We have carefully examined the site and each design separately with regard to items of importance, and have reached the following conclusions, taking the designs alphabetically:

First—The design furnished by Mr. Wm. Curlett: The elevations show a very imposing group of buildings, treated in a scholarly manner. The Law Building is well planned, and contains everything that is called for. As much cannot be said of the Medical Building, the plan of which is somewhat defective in light and lacking in many of the called-for requirements, the most important omission being the large assembly hall called for in this building. The third building contains the departments of Pharmacy, Dentistry, and Veterinary; the various services of these departments are somewhat intermingled and confused.

Second—The design furnished by Messrs. Krafft, Martens & Coffey: The plans of the several buildings of this design show a thorough study of the requirements. All the services are direct; the different parts are easy of access and well located; the halls, stairs, and rooms are well lighted. The main assembly-room occupies a good position at rear of center building. Its form is excellent and, properly treated, would make a noble hall. The lobbies and doorways at each side should be enlarged somewhat. The exterior of this group of buildings is only shown by a perspective small in scale and not sufficiently studied.

Third—The design by Messrs. McDougall & Son: The elevations present four buildings, each of an entirely different style, as if designed by four different architects at different times, a result which is certainly not to be desired. The plans show buildings unnecessarily large and not well arranged, but great ingenuity has been expended in certain special arrangements.

Fourth—The design presented by Mr. J. C. Pelton: It is very showy and monumental, too much so, perhaps, for practical purposes. The rush necessary to produce so much work in too short a time is evident in the plans, they being too large and too much room is wasted for halls and passageways. The general grouping of the buildings is well adapted to the configuration of the site. The feature of connecting corridors is a good one, both for utility and architectural effect.

Fifth—The design furnished by Mr. Sutton denotes considerable study of detail, but lacks simplicity of planning. The stairs are not well arranged and the different portions do not fit well together. Some class-rooms and other equipments are omitted. The assembly hall is placed at the rear of the Law Building, while the list of requirements calls for it in central building. The elevations presented by this architect are dignified, but the entrances are dwarfed, unimportant, and not well studied. The Law Building is marred by the addition of the assembly hall.

In conclusion: We consider that the best elevations are those presented by Wm. Curlett, and they would form a very imposing and monumental group of buildings.

We are further of the opinion that the group which, if carried out, would best serve the purposes intended and would make the best and most commodious buildings, is, without doubt, the one furnished by Messrs. Krafft, Martens & Coffey, *which we place at the head of the list.*

As to cost, we will state that in ordinary practice the cost of buildings is governed solely by the price of labor and material, and the quantity of each required in any building. We can, therefore, take it for granted that to cover the same surface of ground with buildings of the same character, built of the same material, the cost will be the same.

Judging from that standpoint, we find that the designs of Messrs. Krafft, Martens & Coffey, and of Mr. Sutton, are, in our opinion, the most economical of those presented, being about equal as to cost. Next higher would be the design of Mr. Curlett. Messrs. Pelton and McDougall's designs being highest, the greater surface covered by the buildings of Messrs. McDougall being offset by the more costly architectural features of Mr. Pelton's production.

We also find that the buildings of Messrs. Krafft, Martens & Coffey, and of Mr. Sutton, do not contain more than is required by the printed circulars, and that the space in both of these designs has been thoroughly utilized; that is to say, we do not think that the requirements could have been filled in smaller buildings.

Having computed the probable cost of the erection of the buildings shown by these two designs, we find that the construction of either group would far exceed the full amount of the appropriation.

Respectfully submitted.

ALBERT PISSIS.
CLINTON DAY.
WALTER J. MATHEWS.

Report of Committee on Grounds and Buildings.—Regent Martin submitted the following report:

At the last meeting of your honorable body, the Committee on Grounds and Buildings made a full and complete report of all proceedings taken by them at their different meetings, for securing plans for the erection of the Affiliated Colleges buildings, by the appointment of a commission of architects to critically examine the various plans that had been submitted, with instructions to report their conclusions. Consequently, a report was duly filed with the Secretary of the Board and was presented at an adjourned meeting of this Board, held on the 19th and 20th instants, at which time the College plans were fully discussed for two consecutive days, when the Regents, after the fullest deliberation and most careful consideration, by ballot, selected the plans presented by Krafft, Martens & Coffey, the plans commended by the commission of architects as the most satisfactory for adoption by the Regents. The minutes of the meeting of to-day will show the formal proceedings of acceptance, which will be offered for your approval to-day. [Received and ordered spread on the minutes, February 20, 1896.]

Acceptance of Plans, etc., for Affiliated Colleges Buildings.—Regent Rodgers offered the following resolutions:

Resolved, That the Board of Regents hereby accepts and adopts the plans and specifications of Messrs. Krafft, Martens & Coffey for the Affiliated Colleges buildings, submitted by them in pursuance to the advertisements heretofore given by this Board. [Adopted, on a call of the ayes and noes, February 20, 1896.]

Resolved, That said Messrs. Krafft, Martens & Coffey, architects, be required to deliver to the Secretary of the Board of Regents full working plans and specifications for the said buildings within forty days from this date. [Adopted February 20, 1896.]

Resolved, That the Secretary proceed to advertise for proposals to erect said buildings upon receipt of said plans and specifications above referred to, pursuant to requirements of Act of 1876 and amendments thereto. [Adopted February 20, 1896.]

Resolved, That the bonds required to be given by said architects shall be approved by the Chairman of the Committee on Grounds and Buildings before said bonds shall be deemed to be accepted by this Board. [Adopted February 20, 1896.]

Plans, etc., of Unsuccessful Architects to be Returned to Them.—Regent Budd moved that the plans and specifications of the unsuccessful architects be returned to them, with the thanks of the Board, and that the plans of Messrs. Krafft, Martens & Coffey be retained by the Secretary. [Carried February 20, 1896.]

Thanks to Unsuccessful Architects.—Regent Rodgers offered the following resolution:

Resolved, That the thanks of the Board be returned to the following-named architects: Messrs. McDougall & Sons, J. C. Pelton, Albert Sutton, William Curlett, who, with great industry and care, submitted to this Board elaborate and most creditable plans and specifications for the proposed Affiliated Colleges buildings. [Adopted February 20, 1896.]

Committee on Grounds and Buildings to Approve Working Plans, etc.—Regent Martin, Chairman of the Committee on Grounds and Buildings, reported that the committee had held a meeting, and had decided to recommend to the Board that the detailed working plans, and specifications and estimates, for the buildings for the Affiliated Colleges be approved as submitted to the Committee on Grounds and Buildings, and to the Board.

Regent Phelps moved that the committee in charge approve the working plans, and specifications and estimates, as submitted to the Committee on Grounds and Buildings, and Board, if not exceeding $250,000, and that upon such approval, they be transmitted to the Governor of the State, the State Treasurer, and the Secretary of State for their approval. [Concurred in April 7, 1896.]

Report of the Law Committee in re Contract to be Signed by Mr. Sutro.—Regent Wallace called on the Counsel of the Board, J. B. Mhoon, who reported as follows:

In connection with the Law Committee, and under instructions from the Board to put in the form of a contract to be signed by Mr. Sutro, with reference to the site for the colleges, and other considerations for the acceptance of that site, I made an appointment with the Law Committee to meet at Mr. Sutro's chambers in the City Hall on the day following the last meeting on which this Board met, last Wednesday. We met at Mr. Sutro's office, Mr. Sutro being present, and Regents Wallace, Foote, Slack, Reinstein, and myself. We there discussed the matter, and submitted to Mr. Sutro the former contract, prepared some months ago upon the instructions of this Board, for Mr. Sutro's signature.

The original having been previously delivered to him, and by him stated to have been mislaid, the interview led to an agreement that I should prepare another contract and submit it to Mr. Sutro. I did so prepare another contract, and undertook to get some of the committee to meet Mr. Sutro again, though there was no formal agreement to that effect. Yesterday Judge Wallace and myself met Mr. Sutro, talked over the matter, and then submitted to Mr. Sutro, about this hour yesterday, the last contract prepared, made up with care from Mr. Sutro's letters which I have in my hand, and submitted that agreement to Mr. Sutro. Mr. Sutro said he would take the agreement under consideration, and advise us to-day as to what action he would take in reference to the agreement. The contract was submitted to Regents Rodgers and Wallace, and then delivered to Mr. Sutro.

Regent Marye offered the following resolution:

Resolved, That the matter be postponed for three weeks to a special meeting to be held at that time, to enable Mr. Sutro to further consider whether he will sign the written contract submitted to him yesterday, and embodying the various inducements held out by him to procure the acceptance of the Affiliated Colleges site, and that in the meanwhile Mr. Sutro be authorized and requested to confer with the Law Committee of the Board, and the committee is requested to confer with Mr. Sutro on the subject as he may request. [Concurred in April 14, 1896.]

Deed to the Regents of the University of Land Donated by Hon. Adolph Sutro.

This Indenture, made and entered into on this the 8th day of October, in the year of our Lord one thousand eight hundred and ninety-five, between Adolph Sutro, of the City and County of San Francisco, State of California, party of the first part, and the Regents of the University of California, party of the second part,

Witnesseth: Whereas, an Act entitled "An Act appropriating two hundred and fifty thousand dollars for the erection of buildings for the use of affiliated and other departments of the University of California," was duly passed by the Legislature of the State of California, and approved on the 23d day of March, 1895, by the Governor, which said Act is in words and figures following, to wit:

"The People of the State of California, represented in Senate and Assembly, do enact as follows:

"Section 1. The sum of two hundred and fifty thousand dollars is hereby appropriated out of any money in the State Treasury not otherwise appropriated, to be paid to the Regents of the University of California, to be expended by them in the erection of buildings grouped together on such site in San Francisco as the Regents may select, for the use of the professional and affiliated colleges, to wit: The Hastings College of Law, the Medical Department, the College of Dentistry, the College of Pharmacy, the Biological Laboratory, University Extension Lectures, and other departments of the University of California conducted in San Francisco. And the Controller of State is hereby authorized and directed to draw his warrants for said sum at such times and in such partial payments as he may be requested by said Regents of the University of California, and the Treasurer of the State is hereby directed to pay the same; provided, however, that one half of said sum of two hundred and fifty thousand dollars shall be expended during the forty-seventh fiscal year, and the other half during the forty-eighth fiscal year.

"Section 2. This Act shall take effect and be in force from and after its passage."

And whereas, Adolph Sutro, party of the first part hereto, has offered to the Regents of the University of California a site for the erection of buildings to be grouped together thereon in compliance with and for the purposes mentioned in said Act, and to be held by the said Regents of the University of California under certain conditions—five in number—hereinafter mentioned, all that certain piece or parcel of land, situate, lying, and being in the said City and County of San Francisco, State of California, particularly described as follows, to wit:

Commencing at the southeast corner of Fourth Avenue and J Street; thence along the south line of J Street north 70° 19′ east, eight hundred and ninety-six feet seven and one half inches (896′ 7½″) to a point on the west line of First Avenue, if the same were continued in a southerly direction; thence south 3° 15′ east, being a line in continuation of the west line of First Avenue, seven hundred and eighty-seven feet six inches (787′ 6″); thence at right angles south 86° 45′ west, eight hundred and sixty feet (860′) to the east line of Fourth Avenue; thence at right angles and following along the east line of Fourth Avenue, five hundred and thirty-three feet ten inches (533′ 10″) to the point of commencement. Containing an area of thirteen and forty-three thousandths (13.043) acres; the said land aforesaid being herein referred to as the "Affiliated College site."

And the said the Regents of the University of California, party of the second part hereto, have duly accepted and do hereby duly accept the said offer of the said Adolph Sutro, party of the first part, with the said conditions hereto annexed, as aforesaid in that behalf.

The conditions aforementioned, and to the observance of which conditions, and each and every one thereof, the said the Regents of the University of California, party of the second part, hereby—and by their acceptance of this indenture bind themselves, are as follows, to wit:

First—That said Affiliated College site is to be devoted exclusively to the use and benefit of the Affiliated Colleges of the University of California, and no building shall be placed thereon which is not necessary or appropriate for collegiate purposes.

Second—That all buildings and structures erected thereon shall be, as far as practicable, fire-proof as against fire arising internally or externally, and no dwelling or residence shall be placed on said Affiliated College site, except a building for the use and residence of the janitors, which building shall be, as far as practicable, fire-proof, and so far removed from the other buildings as to reduce the danger of fire therefrom to a minimum.

Third—That no building erected on the said Affiliated College site shall be nearer than twenty-five feet to the southerly prolongation of the westerly line of First Avenue.

Fourth—That the College buildings must be erected on said Affiliated College site, and said Affiliated College site and buildings must be used solely for the purposes of Affiliated Colleges of the University of California.

Fifth—That work on said buildings mentioned in said Act of the Legislature must be commenced by the party of the second part within six months from the date of these presents, and said College buildings, to the extent of the appropriation heretofore made therefor by said Act, must be completed within five years from the commencement of the work.

And the said "The Regents of the University of California," party of the second part, having duly accepted the said offer of said Adolph Sutro, party of the first part, subject to each and every of the conditions hereinbefore expressed:

Now, therefore, the said Adolph Sutro, party of the first part aforesaid, in consideration of the agreement and promise of the said the Regents of the University of California, party of the second part, to erect the said buildings for said collegiate purposes, and to faithfully keep and observe all and singular the conditions hereinbefore enumerated and set forth, has granted, sold, and conveyed, and does by these presents, grant, sell, convey, and confirm unto the said party of the second part, the Regents of the University of California, the land and premises hereinbefore particularly described, containing the area of thirteen and forty-three thousandths acres of land, together with all and singular the tenements, hereditaments, and appurtenances thereunto belonging or in anywise appertaining; to have and to hold all and singular the said premises, together with the appurtenances, unto the said party of the second part and their successors forever, subject to the conditions aforesaid; but for breach upon the part of the party of the second part of any of said conditions, the title to the said land hereinbefore described shall revert to and vest in the said party of the first part, his heirs and assigns.

In testimony whereof, the said party of the first part has hereunto set his hand and seal at the City and County of San Francisco, State of California, the day and year first in this indenture above written.

ADOLPH SUTRO. [Seal.]

Signed, sealed, and delivered in the presence of

J. H. C. Bonté.
A. C. Unsworth.

State of California,
City and County of San Francisco. } ss.

On the ninth day of October, A. D. one thousand eight hundred and ninety-five, before me, John F. Lyons, a Notary Public in and for the City and County of San Francisco, State of California, residing therein, duly commissioned and qualified, personally appeared Adolph Sutro, known to me to be the individual described in, whose name is subscribed to, and who executed the annexed instrument, and he duly acknowledged to me that he executed the same.

In witness whereof, I have hereunto set my hand and affixed my official seal, at my office, in said City and County of San Francisco, the day and year last above written.

JNO. F. LYONS,
Notary Public, in and for the City and County of San Francisco, State of California,
607 Montgomery Street, San Francisco, Cal.

Plans, etc., of Affiliated Colleges Buildings to be Forwarded to Sacramento.—Regent Rodgers moved that the plans and estimates for the buildings for the Affiliated Colleges be immediately transmitted to the Secretary of State, to be acted upon by the Governor, Secretary of State, and State Treasurer, with the request that they be considered and reported upon as soon as possible. [Adopted May 12, 1896.]

Attorney-General Requested to Give his Opinion as to whether Any One of General Acts of Legislature Has Any Application to Erection of Buildings by the Regents.—Regent Wallace offered the following resolution:

Whereas, Section 9, Article XX of the Constitution of the State of California, contains the following language:

> Section 9. The University of California shall constitute a public trust, and its organization and government shall be perpetually continued in the form and character prescribed by the Organic Act creating the same, passed March twenty-third, eighteen hundred and sixty-eight (and the several Acts amendatory thereof), *subject only* to such legislative control as may be necessary to insure compliance with the terms of its endowments and the proper investment and security of its funds.

And whereas, Neither the said Act of March 23, 1868, nor any one of the said several Acts amendatory thereof, purport to contain any legislative provision regulating the methods to be pursued in the erection of buildings by the Regents of the University;

Resolved, That the honorable the Attorney-General of the State of California be and he is hereby respectfully requested to give to the Regents of the University, at his convenience, his opinion as to whether upon the true construction of the Constitution any one of the general Acts of the Legislature of this State, purporting to prescribe and regulate the methods to be pursued in the erection of public buildings, has any just or legal application to the erection by the Regents of buildings for the use of the University. [Adopted May 12, 1896.]

Extension of Time in which to Begin Work on Buildings.—Regent Rodgers moved that the Counsel of the Board read the resolution in regard to the Sutro donation which he was requested to prepare. [Carried.]

The Counsel of the Board then read the following resolution:

Whereas, The Legislature of the State of California, at its last session, did appropriate $250,000 for the purpose of erecting buildings in San Francisco for the use of the several colleges affiliated with the University;

And whereas, No site having been provided for said buildings, the

Board of Regents duly authorized a committee to examine and report upon the matter of such site;

And whereas, While said committee were so engaged, the Hon. Adolph Sutro addressed the following communication to said committee, to wit:

San Francisco, Cal., July 24, 1895.

To the Committee on Selection of a Site for the Affiliated Colleges:

Gentlemen: A number of sites, more or less suitable for the proposed buildings for the Affiliated Colleges, have been offered to you. I have, myself, offered several.

The great objection that has been raised against most of these is, that they are too small for the intended purpose.

You probably know that some years ago I reserved a magnificent site, consisting of twenty-six and thirty-six hundredths ($26\frac{36}{100}$) acres for the Sutro Library, which was specially selected for its admirable protection against a general conflagration (no matter how much the city may extend) by hills that project on either side. This site is situated on the south side of J Street, at an elevation of 400 feet above sea-level, and of 125 feet above Golden Gate Park. It is well sheltered from the westerly winds, has been planted with trees that form a beautiful grove, and commands a superb view of the Park, the Ocean, the Golden Gate, Marin County, and a portion of Contra Costa County. It is less than two blocks from Golden Gate Park, and is directly accessible by two railway lines, and probably a third, which will pass in front of the premises. Its distance from the New City Hall, in an air line, is 13,000 feet, or a little over two miles and a half.

I hereby offer, free of cost, this whole property to the University of California for the erection of buildings for the Affiliated Colleges, only reserving a piece of land for the Sutro Library.

The erection of these buildings will not much impair the Library's security against fire, as the College buildings may be constructed, to a large extent, in a fire-proof manner, and placed a distance of more than 100 feet from the Library building.

The first prerequsite for a College is a library; it makes it doubly advantageous, therefore, to have the College located in its immediate proximity.

Some of the details in regard to the reservation for the library, the grading, the location of the Colleges, etc., will have to be postponed for future discussion and agreement, but I do not think that more than six (6) acres will be required for the Library buildings.

This, of course, is an opportunity for the University, and, through it, for the Affiliated Colleges, to obtain property of great value, which is unsurpassed in location and adaptability for your purposes; and if you desire to meet me to answer any questions you may put, I will be delighted to attend at any time you may mention.

Respectfully yours,

(Signed:) ADOLPH SUTRO.

And whereas, Said communication was duly received and considered by said committee, and thereafter the Hon. Adolph Sutro sent a second communication to said committee on the same subject, as follows:

San Francisco, Cal., July 30, 1895.

To the Committee on Selection of Site for Affiliated Colleges:

In my previous communication to your honorable body there were many points not covered by my offer of a site, concerning which you would, no doubt, like some information.

First—I wish it understood that I will enter into such appropriate agreements as may be required to secure to the public on the site proposed the very valuable library, whose collection has been the work of many years and whose value cannot really be estimated.

Second—I will convey to the Board of Regents of the University of California the title in fee to the entire tract mentioned in my first letter to you, subject only to the condition that a portion of it shall be set apart for the purpose of a library site. The particular part I wish to be reserved for the purposes of a public library is opposite to First Avenue and is laid out in the inclosed diagram.

Third—As I have devoted my best years to a study of what a general reference library, embracing works in the sciences, arts, and technical subjects, should be, and as I intend to use my own funds in making additions to it, and improving its efficiency, and as I may further endow it, I wish the library—library site and library buildings—to remain under my dominion and control during my life, and after my death under the dominion and control of my trustees.

Fourth—The site must be used only as a site for the Affiliated Colleges and Library. As a security against fire, no private dwellings ought to be erected on the grounds, and the buildings necessary for the Colleges should be separated from the library buildings by a distance of at least 100 feet. As far as practicable, all the buildings and structures should be fire-proof.

Fifth—Mr. Newberry informs me that buildings to the height of 30 feet may be erected on the north side of J Street without obstructing the view. However that may be, as I own all the lots on the north side of J Street (except one school lot) which will be likely to obstruct the view, I will be able to secure, and will secure, an uninterrupted outlook to the park.

Sixth—Mr. Newberry will be able to furnish you approximate information as to all matters concerning grades and grading.

Respectfully submitted.

(Signed:) ADOLPH SUTRO.

And whereas, Said committee having duly received said communication and having personally met said Sutro and discussed the matter, the Hon. Adolph Sutro sent a third communication to said committee, as follows:

San Francisco, Cal., August 9, 1895.

To the Committee on Selection of Site for Affiliated Colleges:

Gentlemen: Referring to my two previous letters, and after having discussed with you the different propositions therein made, I desire now to submit some supplementary proposals for your consideration:

First—I propose that the Sutro Library site, so called, consisting of twenty-six, three hundred and sixty thousandths ($26\frac{360}{1000}$) acres, be divided by a line drawn southerly, parallel to First Avenue, through the center of the 1,612 feet frontage on the south side of J Street, which will divide the tract into two parts. That lying west of said center line I agree to deed free of charge to the Affiliated Colleges, or the University of California, as the case may require. The said tract must be used only for the purposes of the Affiliated Colleges, whose buildings should be as nearly fire-proof as practicable. No dwellings or buildings, other than those intended for collegiate purposes, are to be erected on the grounds. A dwelling for janitors, however, may be erected thereon, but proper care should be taken either to make it fire-proof, or to remove it from the College buildings or Library, so as to lessen the dangers from fire. No College or Library buildings shall approach the boundary dividing line nearer than seventy-five (75) feet, and the space between the College and the Library buildings shall be reserved for a roadway, ornamented by flower-beds and lawns. The trees on the grounds should be so thinned out as to reduce the dangers from fire to a minimum.

Second—I agree that the Library site shall be used only for the purposes of the Sutro Library, free forever to the public without regard to race, color, creed, or other condition of life. The Library buildings and auxiliary buildings for bookbindery, printing offices, etc., may be erected, but no dwellings except one for janitors, subject to the hereinbefore mentioned precaution against fire.

Third—I also agree to endow the said Sutro Library with the lands described as follows: Block bounded on the south side by J Street, on the west by First Avenue, on the north by Carl Street, and on the east by the Byfield tract line; also, part of block 673 between the school lot and I Street and First and Second avenues; also, fractional block 674 between I and J streets, and Second and Third avenues. These blocks are intended as a provisional endowment for the library, and shall not be sold, mortgaged, or encumbered, but may be leased by the trustees of the library for building purposes, and the income devoted to the uses and purposes of the library; provided, that the undersigned reserves the management of the library and lands during his lifetime. No buildings erected on the lots situated on the north side of J Street, opposite to the Collegiate and Library buildings, shall have a height greater than thirty (30) feet above the grade of J Street, so that an unobstructed view of the College and Library buildings from the Park may be preserved.

I hereby further agree, within ninety (90) days from the date of the written acceptance of these propositions, to select a Board of Library Trustees, and to transfer to them, under certain regulations and trusts, not only the library, but also the fee to the library site and the endowment lands hereinbefore described.

Fourth—I submit that work should be commenced on the Affiliated Colleges within ——— days, and that the proposed College buildings should be completed within ——— years from date of written acceptance hereof.

Fifth—These propositions, and the conveyances to be executed by me, are all based on the condition that the lands hereinabove described—

Sixth—These propositions are open for your acceptance in writing, and that of the Board of Regents, for a period of fifteen (15) days from the date hereof.

I will be pleased to communicate further with you on any matter relating to these proposals concerning which you may desire further information.

Respectfully submitted.

(Signed:) ADOLPH SUTRO.

And whereas, Upon a further discussion of said matter by the said committee and the said Sutro, the latter sent a fourth communication to said committee, as follows:

(Extract from Mr. Sutro's letter to Mr. Beckett:)

San Francisco, August 24, 1895.

To the Committee on Site and Buildings for the Affiliated Colleges:

Gentlemen: As requested, I hereby grant an extension of time for the acceptance of the propositions I have made to the honorable committee for two weeks, or until September 6th next, inclusive.

I will grade J Street immediately as far west as Fourth Avenue, commencing at Sullivan Street, so that the street may be used for hauling purposes at once.

I will also sewer the same for the same distance, and make a provisional outlet until proper sewer connections can be established.

I shall complete the library in its principal scientific branches, especially those which concern the four colleges, down to the present day. Old and rare books are not easily obtained, but modern books can readily be purchased from American and European booksellers within a few months after an order is placed.

The reason why they are not completed already is that with our rapidly advancing science the very latest editions should be secured just before the library is thrown open to public use. There is also to be provided periodicals of the different scientific branches, particularly those relating to the four Affiliated Colleges.

I look upon the present Sutro Library as but a nucleus of what it will be. It shall be my life's work and pride to make it the most complete reference library, embracing the sciences, arts, and mechanics, upon the American continent, and it is quite possible that in time its volumes will be double or triple the number contained now.

Respectfully submitted.

(Signed:) ADOLPH SUTRO.

And whereas, Said committee having accepted said site upon the conditions mentioned in said several communications aforesaid, and the said action of said committee having been ratified by this Board, and this Board having expressed its acceptance of said donation upon said conditions, thereafter, in further execution of said design to convey said site to the Regents of the University for the said Colleges and Library buildings, the Hon. Adolph Sutro did, on the 8th day of October, 1895, execute and deliver to the Regents a conveyance for the Affiliated Colleges site, as follows:

This Indenture, made and entered into on this the 8th day of October, in the year of our Lord one thousand eight hundred and ninety-five, between Adolph Sutro, of the City and County of San Francisco, State of California, party of the first part, and the Regents of the University of California, party of the second part,

Witnesseth: Whereas, An Act entitled "An Act appropriating two hundred and fifty thousand dollars for the erection of buildings for the use of affiliated and other departments of the University of California," was duly passed by the Legislature of the State of California, and approved on the 23d day of March, 1895, by the Governor, which said Act is in words and figures following, to wit:

"The People of the State of California, represented in Senate and Assembly, do enact as follows:

"Section 1. The sum of two hundred and fifty thousand dollars is hereby appropriated out of any money in the State Treasury not otherwise appropriated, to be paid to he Regents of the University of California, to be expended by them in the erection o buildings grouped together on such site in San Francisco as the Regents may select, for the use of the professional and affiliated colleges, to wit: The Hastings College of Law, the Medical Department, the College of Dentistry, the College of Pharmacy, the Biological Laboratory, University Extension Lectures, and other departments of the University of California conducted in San Francisco. And the Controller of State is hereby authorized and directed to draw his warrants for said sum at such times and in such partial payments as he may be requested by said Regents of the University of California, and the Treasurer of the State is hereby directed to pay the same; provided, however, that one half of said sum of two hundred and fifty thousand dollars shall be expended during the forty-seventh fiscal year, and the other half during the forty-eighth fiscal year.

"Section 2. This Act shall take effect and be in force from and after its passage."

And whereas, Adolph Sutro, party of the first part hereto, has offered to the Regents of the University of California, as a site for the erection of buildings to be grouped together thereon in compliance with and for the purposes mentioned in said Act, and to be held by the said Regents of the University of California under certain conditions—

five in number—hereinafter mentioned, all that certain piece or parcel of land, situate, lying, and being in the said City and County of San Francisco, State of California, particularly described as follows, to wit:

Commencing at the southwest corner of Fourth Avenue and J Street; thence along the south line of J Street north 70° 19′ east, eight hundred and ninety-six feet seven and one half inches (896′ 7½″) to a point on the west line of First Avenue, if the same were continued in a southerly direction; thence south 3° 15′ east, being a line in continuation of the west line of First Avenue, seven hundred and eighty-seven feet six inches (787′ 6″); thence at right angles south 86° 45′ west, eight hundred and sixty feet (860′) to the east line of Fourth Avenue; thence at right angles and following along the east line of Fourth Avenue, five hundred and thirty-three feet ten inches (533′ 10″) to the point of commencement. Containing an area of thirteen and forty-three thousandths (13.043) acres; the said land aforesaid being herein referred to as the "Affiliated College site."

And the said the Regents of the University of California, party of the second part hereto, have duly accepted and do hereby duly accept the said offer of the said Adolph Sutro, party of the first part, with the said conditions hereto annexed, as aforesaid in that behalf.

The conditions aforementioned, and to the observance of which conditions and each and every one thereof, the said the Regents of the University of California, party of the second part, hereby and by their acceptance of this indenture bind themselves, are as follows, to wit:

First—That said Affiliated College site is to be devoted exclusively to the use and benefit of the Affiliated Colleges of the University of California, and no building shall be placed thereon which is not necessary or appropriate for collegiate purposes.

Second—That all buildings and structures erected thereon shall be, as far as practicable, fire-proof as against fire arising internally or externally, and no dwelling or residence shall be placed on said Affiliated College site except a building for the use and residence of the janitors, which building shall be, as far as practicable, fire-proof, and so far removed from the other buildings as to reduce the danger of fire therefrom to a minimum.

Third—That no building erected on the said Affiliated College site shall be nearer than twenty-five feet to the southerly prolongation of the westerly line of First Avenue.

Fourth—That the College buildings must be erected on said Affiliated College site, and said Affiliated College site and buildings must be used solely for the purpose of Affiliated Colleges of the University of California.

Fifth—That work on said buildings mentioned in said Act of the Legislature must be commenced by the party of the second part within six months from the date of these presents, and said College buildings, to the extent of the appropriation heretofore made therefor by said Act, must be completed within five years from the commencement of the work.

And the said "The Regents of the University of California," party of the second part, having duly accepted the said offer of said Adolph Sutro, party of the first part, subject to each and every one of the conditions hereinbefore expressed:

Now, therefore, the said Adolph Sutro, party of the first part aforesaid, in consideration of the agreement and promise of the said "The Regents of the University of California," party of the second part, to erect the said buildings for said collegiate purposes, and to faithfully keep and observe all and singular the conditions hereinbefore enumerated and set forth, has granted, sold, and conveyed, and does by these presents grant, sell, convey, and confirm unto the said party of the second part, the Regents of the University of California, the land and premises hereinbefore particularly described, containing the area of thirteen and forty-three thousandths acres of land, together with all and singular the tenements, hereditaments, and appurtenances thereunto belonging or in any wise appertaining; to have and to hold all and singular the said premises, together with the appurtenances, unto the said party of the second part and their successors forever, subject to the conditions aforesaid; but for breach upon the part of the party of the second part of any of said conditions, the title to the said land hereinbefore described shall revert to and vest in the said party of the first part, his heirs and assigns.

In testimony whereof, the said party of the first part has hereunto set his hand and seal at the City and County of San Francisco, State of California, the day and year first in this indenture above written.

ADOLPH SUTRO. [Seal.]

Signed, sealed, and delivered in the presence of

J. H. C. BONTÉ.
A. C. UNSWORTH.

STATE OF CALIFORNIA,
City and County of San Francisco. } ss.

On the ninth day of October, A. D. one thousand eight hundred and ninety-five, before me, John F. Lyons, a Notary Public in and for the City and County of San Francisco, State of California, residing therein, duly commissioned and qualified, personally appeared Adolph Sutro, known to me to be the individual described in, whose name is subscribed to, and who executed the annexed instrument, and he duly acknowledged to me that he executed the same.

In witness whereof, I have hereunto set my hand and affixed my official seal, at my office, in said City and County of San Francisco, the day and year last above written.

[SEAL.] JNO. F. LYONS,
Notary Public, in and for the City and County of San Francisco, State of California,
607 Montgomery Street, San Francisco, Cal.

And whereas, Said conveyance has been duly received and the donation of said site accepted, as appears by a resolution of this Board, of record in the minutes, and said conveyance has been duly recorded in the office of the Recorder for the City and County of San Francisco;

And whereas, It appears, by the fifth condition recited in said conveyance, that work on said buildings was required to have been commenced by the Regents within six months from said 8th day of October, 1895, the Hon. Adolph Sutro to avoid any question under said fifth recital, did transmit to this Board the following communication:

SAN FRANCISCO, May 2, 1896.

To the Regents of the University of California :

To the deed for the Affiliated College site executed by me to the Regents of the University of California, dated October 8, 1895, and recorded in the Recorder's office of the City and County of San Francisco, State of California, on the same day, was attached the condition that work on the College buildings must be commenced within six months and, to the extent of the appropriation therefor, completed within five years from the date of the deed. That condition has not been complied with, inasmuch as the work on the buildings has not been commenced, although six months from the date of my deed to you have elapsed.

This breach in one of the conditions of the deed results in the reversion to me of the title to the site, unless I grant an extension of time within which you were required to commence work.

You have requested that the time provided in the deed for the commencement of the work be extended six months. This extension of six months additional to that set out in the deed I hereby grant you.

Should you fail to commence work within the six months additional—that is, on or before the 8th day of October, 1896—then it is understood that the title of the property reverts to me. All the other terms, conditions, and covenants of the deed heretofore made are continued in full force as therein made.

Very respectfully,

ADOLPH SUTRO.

Now, therefore, be it resolved, That in view of the generous donation of the said site for the Affiliated Colleges, heretofore accepted, and the noble plans undertaken and promised by the Hon. Adolph Sutro, as expressed in his letters above set out, for founding and endowing a great public library in connection with said Colleges, this Board does now gratefully accept said undertakings so expressed in said letters; and in consideration therefor will proceed to erect said College buildings upon said site as provided by law, and will earnestly further the design of the Hon. Adolph Sutro in founding and completing the said Library and Library building;

Further resolved, That this Board take this occasion to express its profound appreciation of the public spirit, devotion to learning, and the good of the commonwealth, so splendidly manifested by the Hon. Adolph Sutro.

On motion, the resolution was adopted. [May 19, 1896.]

59. Report of Committee on Ways and Means.

San Francisco, May 20, 1896.

To the Honorable Board of Regents of the University of California:

The present financial straits of the University of California could hardly be indicated more clearly and strongly than by the creation of the committee which makes this report. Despite an administration of the finances of the University, during the last twenty-seven years, which is almost unparalleled for its excellence, an administration which has carefully considered and critically checked every expenditure, and which may boast justly of the fact that not a single dollar of the University's funds has been lost by any investment during that long period, and despite the time and care and thought and attention given to the University's finances for years, by many, if not all of the members of this body, whose success in life is a guarantee of ability to overcome such difficulties as the University now faces, this Board has found the financial situation so grave and so pressing as to call for the creation, for the first time in the history of the University, of a Ways and Means Committee, to specially consider and report upon the financial outlook of the State University.

Apparently the only alternative which now presents itself is, that either a considerable deficit in the University's funds must be created, a course never before taken, or the actual teaching force at the University must be curtailed. In other words, the Regents, as trustees, must expend more than the income of the trust fund, or there must be a restriction in the number of the beneficiaries of that fund, which was created solely to give to the largest possible number of such beneficiaries the benefits of a higher education.

As the Committee on Internal Administration well say: "Last year we cut many lines of work short, denied well-earned salaries, none of which are too high and many of which are too low." Some instructors are rendering efficient service for the wages of a cash boy. There are no useless or high-salaried professors, and hardly one who could not better his condition financially by leaving us, and hardly one whose University duties do not require his attention for more hours than the common laborer works. There is no money to care for the grounds of the University at Berkeley, and its buildings have been unpainted for several years. Professors threaten to leave us to accept more lucrative offers, while the many money injustices to the professors and teachers, necessarily resulting from our limited means, must destroy the *morale* and effectiveness of the teaching force. With no money for lighting the grounds or library, and a student roll which overtaxes the physical accommodations and the time and energies of the teaching force at the University, it is no wonder that the feeling is general that the youth of the State are turned away from its highest institution of learning to other colleges, where not only do we believe they will receive a less excellent instruction, but *they will lose that patriotism, love, and pride for the State of California* which will result inevitably from their additional obligation to their State, as the donor to them of the benefits of higher education.

It is with a thorough-going and keen appreciation of this situation and these alternatives, and in the spirit thereby naturally engendered, that your committee has approached this subject, has taken the counsel and heard the suggestions of the heads of some of the departments of the University, the leading citizens of this State, and many of the graduates of the University, and now files this report upon the subject.

Briefly stated, the condition we are called upon to consider is this: There will be an excess of expenditures over the income of the University of California, on the first day of July of this year, of about thirteen thousand ($13,000) dollars, and the requirements for the coming year will be considerably greater than for the past twelve months, while the income of the University will almost certainly be no greater during the next year, and may be less. The University is growing far more rapidly than could have been anticipated, reasonably, at the time when its financial provisions were made, and the demands upon such finances have already far outstripped and probably will constantly and still further exceed the financial provisions made.

The budget for the year, from July 1, 1896, to July 1, 1897, must now be made up. We are face to face with the question of either leaving the deficit which now exists, and increasing it probably with each succeeding year, or of taking steps now to check further enlargement and spread of the University, and consequently limiting the benefits and advantages derived from a higher education of the youth of both sexes of this State.

Under these circumstances the problem submitted to the attention of this committee is not merely the present deficit, but the probability, almost certainty, of a largely and constantly increasing deficit in the years to come, and it seems to us, therefore, that in any attempt to meet the present imminent requirements of the University, care must be had that our action shall not only not prejudice, but shall regard the University's welfare in the many years to come.

For these reasons, while your committee makes several recommendations on minor matters, and has investigated numerous subjects which may be brought to the attention of this Board, verbally, all of which will tend to reduce the expenses of the University in a slight degree, we have deemed it due to the great importance of the subject of the present and future finances of the University to regard this matter *broadly* in so far as the limited time accorded us by this Board has permitted.

In reference to the present deficit, estimated at $13,000, it will be agreed on all sides that it is most desirable, so far as consistent with carrying out the purposes of any trust, that trustees should keep the expenditures within the income of the trust fund, and as this has not been possible in regard to the University's funds this year, despite the extraordinary and able efforts of the gentlemen who have so carefully conducted the finances of this University, we will first consider what means should be taken, if any, to repay or provide for the present deficit. The sources of relief are, either, (*a*) a legislative appropriation; (*b*) donations by private individuals; (*c*) loans from private individuals, the repayment of which might be anticipated from the appropriation by the next Legislature; (*d*) a tax, under some name, on such of the students of the University as could well afford to pay the same.

Your committee has carefully considered and canvassed all of these propositions.

As the Legislature does not meet until next January, this source of relief is denied us at the present time. We have reached the conclusion and feel assured that relief from the present deficit cannot be had by either private donations or by a loan from individuals, even though its repayment would probably be made by a legislative appropriation next year; and so far as concerns the students we consider that it would be unwise and ill advised to tide over the present emergency by a tax of any kind, or under any name, on any student of the University of California.

We take up this last branch first, and we beg to say, at the outset, that it is a most significant fact, that the supporters, in this Board, of the plan of taxing the students to meet the present deficiency, admit that they do so with the utmost reluctance, and only as a last resort. In other words, that while their sentiments and feelings least incline them to this course, it seems to them the only way out of the difficulty. We believe there is at least one method which will prove, upon comparison with this, both more grateful to our feelings and more consonant with the welfare of the University—one which will recommend itself more strongly to both our hearts and minds; and at the same time we beg to point out to those who feel constrained to advocate a tax on some of the students to provide for the present deficit, that such tax must necessarily constantly increase, as the future prosperity of the University requires greater and greater outlays, unless the Legislature or the generosity of private individuals relieves the situation; and should this relief so come, and it is both probable and near at hand, there will have been two classes of students, those in the past who have not paid, and those now who have, and the present students of the University of California, unless repaid this temporary exaction on them, would forever preclude the statement, which is at once a just and proud claim of this State, that the higher education was furnished, is furnished, and will be furnished by the State of California, to every seeker, absolutely without cost.

It may be a source of suggestion to us, moreover, though it was not intended to influence our action, that at the last meeting of the Alumni Association of this University, a resolution was passed by that body unanimously against placing any such tax upon any student in the University, and we beg to add that in our interviews on this subject with several of the leading citizens of this State, not graduates of any University, they have unanimously opposed such a tax. And it would seem to us, as it has been suggested to us, that such tax should not be placed upon the students of the University, at least, until the representatives of the people, with a full knowledge of the situation, have denied other provisions for the education of the youth of this State, and have made such a tax a last resort; and as a final answer to this question the Governor of the State has pointed out the fact that the law prohibits our making any such exaction on the students.

In reference to donations by private individuals to pay this deficit, we beg to say that we have interviewed a number of the citizens of this State, whose generosity on all occasions has been equalled only by their sincere and hearty interest in the welfare of the State University; and assuming that the position taken by Mr. Louis Sloss, one of the most conspicuous of such gentlemen, would fairly typify the attitude of other citizens who might be able to aid in this emergency, we have come to the conclusion that we should be unable to obtain sufficient donations to pay the present deficiency. It would not further the desired end to state the reasons given by those whom we have approached on this subject, and to whom we have submitted also the second proposition, that they should advance sufficient money to pay this deficiency, upon a promise of the Board of Regents that the next Legislature would repay, in all probability, the amounts thus borrowed, and we must report that we do not believe this method feasible, for, as has been well stated to us, the Legislature will either appropriate the necessary moneys or it will not. If it should not do so, the Board of Regents would be placed in an embarrassing position, and a considerable number of the leading citizens of this State might have cause of grievance, which might possibly be visited upon the University; and if the Legislature does make the appropriation, these gentlemen say that there is no reason why the University should not go into debt, with a practical certainty that such debt will be canceled within less than a year.

The suggestions made by those whom we have approached with these various propositions, and the counsel of the heads of some of the departments, and the older graduates of the University of California, with all of whom we have gone into this subject somewhat extensively, lead us to the conclusion which we now beg to submit to the Board, and that is, that *the best way out of the University's present and prospective indebtedness is so to conduct the affairs of the University as to minister to its highest and best welfare, and to the fullest interests of the State, which depend upon it; and at any rate, and in no event, to curtail the University in any of its powers, purposes, or efficiency, and rather than this, to increase the present deficiency if necessary. We believe, in brief, that the worst way to right the University's finances is to wrong the University.*

We cannot refrain from quoting, in this behalf, the strong, and, to us, convincing language, so frequently used by Regent Wallace, which we feel should deeply impress, and if not control, at least guide us in our deliberations on this question. As he so well puts it, "The question presented to us always is, shall we have a surplus of students and a deficiency in our bank account, or shall we have a surplus in our bank account, but a deficiency of students?" As he has said, the Board of Regents was *organized* to carefully and thoughtfully expend money in giving the best possible education to the largest number of students. We are created to make wise expenditures for that special purpose, and it is for the State to meet any deficiency which shall result in the proper carrying out of that end, as we believe it will do, through the representatives of the people, both cheerfully and liberally. We must face the next Legislature with one of two propositions, either a petty deficiency, necessarily incurred in carrying out properly the purposes of the University, or an admission that we have not carried out those purposes, but there is a little less deficiency, and we believe, in the light of the past liberality of the State toward the higher education, that there is no reason to doubt as to which of these courses we should take.

It must be borne in mind, as was well suggested in our conferences, that *this deficiency is not of our making;* it is due simply to the fact that the people of the State, be it said to their credit and to the credit of the University, have sent their sons and daughters to the University in such numbers, that, thereby, the expense of educating the youth of this State has exceeded the provision made by the State for that express purpose, and we believe that no step whatever should be taken to now meet this deficiency or the certain future deficiencies, and at least none that will restrict in any way the powers and the purposes of the University of California, until the representatives of the people, assembled in the halls of the Legislature, shall determine that, in their judgment and in the interest of the people, there should be such restriction ; and we may add that we are confident that, upon a proper submission of the situation, the Legislature, in the best interest of this State, will enlarge the facilities the State now offers, which facilities are no longer adequate to the constantly increasing demands of the people for higher education, and will rise, not only equal, but superior, to the present demands of the University. Our reasons for this conclusion, which we think should be controlling with this body, as we believe they will be effective with the Legislature, are as follows :

The provision made by the State of California for the constantly increasing wants of the State University is embodied in the Act of the Legislature of 1887, and consists of a tax of one tenth of a mill on the dollar.

At that time the number of students in the University was 288, while now it is 1,336. The provision then made by the Legislature was considered just sufficient for the then needs of the University, and it was anticipated that the taxable wealth of the State would increase in just about the proportion that the University would grow, and thus meet and provide for the constantly increasing demands of the University through the enlargement of the number of its students. This expectation seemed then to be well founded, and was justified by the growth of the University for the succeeding four years, but since the year 1891 the number of students at the University, which was then 456, has increased to a degree as remarkable as it is gratifying.

Within the last five years the number of students at the State University at Berkeley has trebled, and is at the present writing, 1,336, while in the entire University, including its affiliated colleges, the number is 2,047, while the indications are that the next Freshman class will outnumber all before it. The income of the University from this Act, however, so far from doubling, has increased only an insignificant amount within the last five years, and is actually less in 1895 than in 1894 or 1893.

Under these circumstances alone, it is but reasonable to believe that the next Legislature will take such steps as will be commensurate with the power, the pride, and the dignity of a sovereign State, when it realizes that the provision for the support of the University made by the Legislature in 1887 is entirely inadequate to the present quadrupled demands of the University, and still less adequate to maintain that constantly increasing prosperity of the State's highest institution of learning, which is a just source of State pride, and an essential condition of State dignity and prosperity.

This State is marked and noted for a liberality commensurate with her extensive domain and the richness and variety of the products of her soil, and were it for no other reason than to maintain the reputation she now has throughout the Union, in this particular regard, we believe the representatives of her people at the next Legislature will make the provision necessitated by the University's unexampled prosperity.

And as a spur and stimulus to such action, though none will be needed, we can point to the State of Missouri, which gave to its University in 1891, $1,000,000, and in 1893, nearly $300,000; to the State of Wisconsin, which has given to its University $1,200,000, which grants it a permanent tax of one eighth of a mill on the dollar, and in addition, for six years, one tenth of a mill for buildings, and in addition, one per cent of the railroad license tax, which yields more than $10,000 per annum, and further specific appropriations of recent date, amounting to $110,000; to the State of Michigan, which gives its University a tax of one sixth of a mill on the dollar, nearly double our rate; to the State of Minnesota, which gives its University three twentieths of a mill on the dollar, one and one half times as much as our rate; to the State of Nebraska, which gives nearly four times as much as our rate; to the State of Indiana, which gives one half of a mill for thirteen years, for endowment—five times the amount of our present rate.

These facts we believe will not only justify, but move, the State of California to take such steps that this State shall not suffer by an invidious comparison with any other State in this Union; and we feel sure that the regard for higher education in this State will so actuate members of the next Legislature that such education shall not be denied by this State to any seeker of either sex or from any place.

Our demand for such increased revenues for the University is but a corollary of the people's own action. Had the people been content, within the last four years, to send no more of their sons and daughters to the University than were sent at the time the State made its appropriation for their education, we should not now be confronted with this deficiency; but, as those people have concluded to send to the University more than quadruple the numbers of 1887, we are justified in believing that their action means that provision shall be made by the Legislature and is demanded by the people for the education of this enlarged and constantly increasing number.

We think we understand and appreciate the sentiment in this body, that the University's expenditures shall be restricted to the University's income, but we also believe that a *truer* construction of our duty requires that the *purposes* of the trust should be *paramount*, and, as the people's action has enlarged those purposes beyond the provisions heretofore made to carry them out, we believe that those who have made the expense are willing to foot the bill.

Even those who are most conservative in this regard admit that there are some circumstances under which a deficiency would not only be justifiable, but would be demanded by every motive which should appeal to trustees in the carrying out of their trust. It is readily recognized and freely admitted that if any of the buildings of the University should burn down, a deficiency would have to be made in order that the students should be housed, but it should be, as it seems to us it will be, just as apparent that, whether the lack of accommodations be due to such a misfortune as fire or whether it be due to a correspondingly good fortune, such as a remarkable increase in the number of students, the *reason* for making such deficiency, that is, the lack of accommodations, would apply in one case precisely as in the other, and so with reference to a deficiency in any other regard, or for any other purpose vital to the proper administration of the trust.

The question is not whether we should have a deficiency. The deficiency already exists, and, like the poor, with our present rate, it bids fair to be with us always; the question is simply, shall that deficiency be $13,000 or $20,000 this year?

Moreover, such deficiency is the only measure by which can be determined the exact amount which should be devoted by the Legislature for University purposes; in other words, the deficiency is simply the exact measure of the University's increased requirements. If those purposes be prevented or hindered by an attempt to keep the expenditures within the income, there never will be any method of determining exactly what amount is required for the highest efficiency of the University. But if the purposes of the University be carried out, thoroughly and well, every expenditure being thoughtfully and cautiously made, the amount of the deficiency at the expiration of any year will mark exactly what the Legislature should appropriate in order that the University may best subserve the ends for which it was created.

So far as concerns the deficit this year, or any future deficit, until the next Legislature meets, our position will certainly be justified by the extraordinary demands which have been made upon the finances of the University—demands which were not provided for because they could not reasonably have been expected; demands which would not exist in the ordinary and usual growth of a University.

And, believing that our position is well justified by the situation, and that the deficiency which now exists needs no excuse, except, perhaps, that it might well have been greater, and believing that there has been no time in the history of the University more fitting to increase that deficiency in order to aid, not only the final and greater prosperity of the University, but also two great industries upon which the prosperity of the State so largely depends—mining and agriculture—the furtherance of both of which was within the purview of the founders, and should be within the duties of the State University, we make the following suggestions:

We wish to say, at the outset, to avoid any misconstruction or misunderstanding of our ideas, that we earnestly desire and sincerely expect that our recommendation will add to the dignity, increase the influence, and enlarge the scope of the literary, classical, and scholastic sides of the University, and we reiterate this with all the emphasis in our power.

But we must not forget, on the other hand, that the Act of Congress which founded this State University, in July, 1862, as one of a system of State Universities throughout the Union, expressly declared that the endowment was "for the support of at least one college where the leading object should be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such a manner as the Legislatures of the States may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life."

The conditions of this endowment are that military instruction should be given, and that one of the leading subjects taught at these State Universities should be agriculture, thus safeguarding the existence of the Nation in time of war, and guaranteeing, in time of peace, a manifold material return to the people of the State, through a knowledge which would increase the value, variety, and amount of the products of the soil.

The endowment thus tendered and accepted by us makes it the *duty* of this Board to see that the Mining and Agricultural Departments of the State University should be so conducted as to minister to the material welfare of the State in these two great sources of her wealth. And the recent action of our State Legislature in turning over to the University the Bureaus of Viticulture and Forestry has plainly indicated this to be the strong *desire* of the people of the State, a desire thoroughly appreciated by the President of this Board, who has done more, perhaps, than any other person to bring about this proper relation between the State and the State University. While we may admit that this Board has appreciated this entire matter, it must be as freely admitted that, by reason of the straitened conditions of the University's finances during the last five years, the Mining and Agricultural Departments of the University have received neither the share of attention nor the amounts of money we all should have desired.

Without making any invidious distinction, we feel that we shall not be unjust by delaying, for, we hope, but a brief period, the consideration we believe will soon be accorded to the great mining interests of our State, and calling your attention to the more pressing wants of the agricultural interests.

Our reasons for so doing are, that agriculture is specially mentioned as one of the leading subjects to be taught at the State University; that the scientific knowledge essential to the success and prosperity of agriculture is better known, may be more easily and quickly applied and with more immediate and more certain beneficial results, and because the present great depression in the agricultural interests of this State makes our attention to that commanding factor of our State prosperity a more pressing and perhaps a more vital duty.

We by no means forget the splendid, but limited, work of the Department of Agriculture in the State University; but a handful of men, however able and however industrious, and the professors in that department are both, cannot be, and should not be expected to exert the prolific influence of their skill and learning throughout a State whose boundaries are equaled only by the bounty of Nature, which has blessed almost every part of it with a capacity and variety of soil products unequaled in any other part of the globe.

The products of the soil in the year 1895 are roughly estimated as follows: Wheat, $13,250,000; barley, $4,500,000; corn, oats, and rye, $3,500,000; hay, $12,000,000; beans, $1,500,000; potatoes, $750,000; onions, $250,000; green and dried fruits, raisins, wine, and grapes, citrus fruits, ripe and dried, $24,000,000; wine, $5,600,000; grape brandy, $2,000,000; hops, $1,350,000; sugar beets, $2,000,000; all other products, say, $2,000,000; making a total of, say, $72,000,000.

It is, we believe, far within the truth to say that, if the present scientific intelligence and knowledge in regard to agricultural matters were generally applied throughout this State, an increase in the above values of at least five per cent would result, which would mean a saving to the State of over ten times the total expenses of the entire University; while an enormous additional saving to the State could be made by preventing the waste and loss of time, energy, and money in vainly attempting to raise products in a way, or upon soils so unfitted to success, that failure is inevitable.

And though we believe we recognize fully the paramount advantages of a great University in the broader and loftier life which is a natural result of the higher education of the citizen, we should not forget that in the wisdom of the Republic which founded these State Universities, one purpose was never lost sight of by her statesmen, and should not be by us, and that was: "To promote the liberal and practical education of the industrial classes in the several pursuits and professions in life"—a duty we have fulfilled well for the professions in the affiliated colleges of the University in Law, Medicine, Dentistry, and Pharmacy, and which we believe can be, and should be, more fully carried out for Mining and Agriculture.

To accomplish these purposes, which have been enjoined on us as duties, we would suggest that the State should be divided, as soon as possible, into proper districts, and that there should be sent into those districts, immediately, authoritative representatives of the University, who should, at stated times and places, of which ample notice should be given, meet those citizens who are engaged in fruit or vine culture, in general farming, or in dairying, or in stock-raising, and then and there avow to them the desire and the duty of the University of California to have a more thorough understanding of the requirements and wishes of the citizens engaged in such pursuits, and the powers, the purposes, and the means of the State University, in that behalf, all with the view of increasing the variety, value, and amount of the products of our soil. In other words, we hope that just as the University has done much for *education*, by its visitation of all the schools in the State, so the University, through its Agricultural Department, will do equally well, if not better, for the material interests of the State, by a similar system of visitation.

We have been waited on by Professor Hilgard, the head of the Agricultural Department of the University, and he has stated to us that his department, without injury to it, though with greater demand on its time, can have fifty meetings throughout the State at widely separated places within the next six months, with those engaged in the various occupations dependent upon the soil, and we have ascertained that this can be done at a cost not to exceed $3,500, and we believe that such money would be expended, not only wisely and well, not only in the interests of the State, but in the fullest and largest sense in the interests of the State University, and without any doubts or misgivings we unanimously recommend the necessary expenditure, not to exceed $3,500, for the accomplishment of the above purposes.

Not only this, but inasmuch as those dependent on the soil, by reason of their isolated situation, are frequently, if not usually, unfamiliar with the markets of the world for their products, the State University should afford frequent and timely and accurate knowledge of these markets and the means whereby they can be reached, that not only should the producer obtain the largest and most lucrative yield, but receive the greatest possible return from the disposition of his products. Yes, and more than this, and in the years to come, perhaps, as important as this, the State University should maintain, in its Agricultural Department, a meteorological bureau, as the other great countries are already doing, which should give, for the benefit of those depending upon the soil, forecasts, not of the day or of the morrow, but with a much broader observation, looking over the data for all past years, forecasts for the farmer of *the seasons to come*, and through our experimental stations, give timely warning of the frost and the dew; matters not beyond our own times, nor even, perhaps, our own day, when a cable to Honolulu and meteorological stations there, and at the Aleutian Islands, shall furnish us data with which such *seasons' forecasts* can be made with reasonable accuracy.

We are well aware that the foregoing report may be deemed somewhat larger in its scope than might be considered by some to be within the purview or the duty of a Committee on Ways and Means; and were the only question before us, or before this honorable body, the mere deficiency for this year, we might have less excuse for both the length and breadth of this report; but we cannot feel, and we hope this body will not, that such is the small and narrow question to which we have been asked to give answer. We feel, as we believe this Board must, if it consider the matter thoughtfully, that it is the existence and conduct of the future, rather than the present University, which we and you are called on to consider; and as the Board has just taken action looking to buildings of the State University for a distant future, so we and the Board may well regard the University's condition when it has risen to dignity, power, and purpose commensurate with the pride, the glory, and the ends of a great and sovereign State; and in this view and on this plane, a Committee on Ways and Means for the conduct of such a University would fail utterly in its duty were it to pass over a means whereby an institution of learning, dependent almost entirely on the good will of the people, could bind those people to it with a bond of material interest, and by the fealty which would spring from the fact that that institution had sent forth a tendril of thoughtful, helpful, and affectionate regard to every acre of soil within the State.

And let us not think that the material welfare of that State is a matter to be despised by us as the controllers of the course and conduct of the State's highest institution of learning. There are already murmurings that the higher education should be neither so costly nor of so little use, especially where primary education is still far from complete; that too many graduates from the University swell the overcrowded professions, and too few of them are willing or able to enter the lower fields of labor; that the State should receive an adequate return for its expenditure for the higher education, in the increased usefulness of the graduates and the greater value of the material resources of the State.

Well has it been said that he is no mean benefactor who causes two blades of grass to grow where but one grew before, and in the rounded-out harmony and purposes of a great University there is room for both those twin results of highest civilization—use as well as beauty.

Let us look at the University of California and teach her faculties, graduates, students, and the people of the State to view her, not only in her buildings at Berkeley—the visible signs of her existence—but in her regard for the intellectual and material welfare of the State, as a lofty, worthy, integral, and important part of the State, and when the University once assumes this attitude, there will be no danger that the State will permit so prominent and so noble a part of her organization to suffer.

Let us recognize also, keenly and deeply, that only by a unanimity of opinion on this subject will we be best able to convince those who have given the University of this State less attention than our duty compels us to give, that the course we may adopt is clear to us as vital to the success and the prosperity of the University of California, and, through the fullest and highest fulfillment of her purposes, to the State of California.

As the result of our labor we earnestly recommend the appropriation of the sum of $3,500 for the payment of the cost of holding fifty meetings throughout the State of those engaged in occupations dependent on the soil, at which the proper representatives of the University shall explain and amplify the foregoing views.

J. B. Reinstein,
Samuel T. Black,
Arthur Rodgers,
Committee on Ways and Means.

Regent Reinstein moved the adoption of the final paragraph of the report of the Committee on Ways and Means, as follows:

"As the result of our labor, we earnestly recommend the appropriation of the sum of $3,500 for the payment of the cost of holding fifty meetings throughout the State, of those engaged in occupations dependent on the soil, at which the proper representatives of the University shall explain and amplify the foregoing views."

On a call of the ayes and noes, the recommendation was adopted. [June 23, 1896.]

60. Changes in the Budget, Year 1895–96.

Expenditures to be Reduced.—Regent Hallidie offered the following resolution:

Resolved, That whereas there will be an existing deficiency in the revenue for the fiscal year 1895–96, it is the intention of this Board to reduce the expenses of the University within the limit of the estimated revenue, and the Committees on Internal Administration and Finance are requested to report a plan to bring the expenditures within the limit of the estimated revenue, at a meeting to be held two weeks from to-day. [Adopted, on a call of the ayes and noes, July 9, 1895.]

Regent Hallidie submitted the report of the Joint Committee (Internal Administration and Finance), as follows:

Pursuant to the instructions contained in the following resolution, adopted at the meeting of the Board held July 9, viz.:

> Resolved, That whereas there will be an existing deficiency in the revenue for the fiscal year 1895-96, it is the intention of the Board to reduce the expenses of the University within the limit of the estimated revenue, and the Committees on Internal Administration and Finance are requested to report a plan to bring the expenditures within the limit of the estimated revenue, at a meeting to be held two weeks from to-day

Your committee recommend, in order to bring the expenditures within the estimated revenue, that the following reductions be made in the General Budget:

Fuel	$500 00
Equipment	500 00
Repairs	500 00
College celebrations	250 00
Official and lecturing expenses	2,000 00
Agriculture	1,000 00
Civil Engineering	750 00
Mechanical Engineering	2,000 00
Lick Observatory	500 00
Mineralogy	250 00

Library		$1,500 00
Museum		250 00
University site		1,500 00
Grading and macadamizing College Way		1,479 22
Astronomy		700 00
Painting buildings		2,000 00
Reservoir		2,000 00
Farmers' Institutes	Morrill Fund	200 00
Laborers, Department of Botany		100 00
		$17,979 22

[Recommendation concurred in July 23, 1895.]

Additions to the Budget for the Year ending June 30, 1896.

Special Appropriations.

1895—July 9	Appropriation for building culvert across Oxford Street	$904 00
July 23	Appropriation for Department of Industrial Arts	300 00
Sept. 24	Appropriation for the German Department	225 00
Sept. 24	Appropriation, addition to salary of Fellow in Pedagogy	20 00
Oct. 8	Appropriation for reprinting 300 copies of first part of Miss Shinn's book	38 00
Nov. 12	Appropriation for the purchase of six McGriff fire-extinguishers	66 00
Nov. 12	Appropriation to cover cost of furnishing electrical power to the several departments	560 00
1896—Jan. 14	Appropriation to cover the cost of visiting schools	1,000 00
Jan. 14	Appropriation for the construction of a footpath 15 ft. wide	750 00
Feb. 11	Appropriation for the purchase of 150 blank diplomas	225 00
Mar. 10	Appropriation for gas in the Civil Engineering Department	32 00
Apr. 14	Appropriation for Summer Schools in Chemistry and Physics	300 00

61. REPORTS OF FINANCE COMMITTEE IN RE PURCHASE OF REAL ESTATE.

Regent Hallidie submitted the following report from the Finance Committee:

To the Board of Regents, University of California:

On February 11, 1890, the Finance Committee was authorized to negotiate the purchase of productive real estate to yield not less than 5% per annum.

On June 14, 1894, the Board added to the Finance Committee, for this special purpose, Regents Crocker and Marye.

Your committee is now prepared to report in favor of the purchase of either of two pieces of property which it submits to the consideration of the Board.

First—That piece of property situate at the junction of Market and Pine streets, forming a gore thereon and known as the Sherwood Block, being a four-story and basement brick building having a frontage on Market Street of 178′ 2⅜″, 225′ 9⅛″ on Pine Street, and 49′ 6″ on Front Street, and containing an area of 13,141 square feet.

Revenue from rentals is, gross per annum		$27,924 00
Expenses—Engineer	$960 00	
Elevator boy	360 00	
Janitor service	120 00	
Coal	1,200 00	
Insurance	241 00	
		2,881 00
Net reported income (taxes not considered)		$25,043 00
Additional deductions made by your committee:		
Janitor in charge	$600 00	
Painting and repairs	600 00	
10% on rentals	2,792 40	
1½% collecting	418 86	
		4,411 26
Net income to Regents		$20,631 74

On an investment of $400,000, this will yield an income of 5.16% per annum.

Second—That piece of property situate on the north side of Sutter Street, between Montgomery and Kearny, about 104 feet east of Kearny, is owned by the Johnson estate, and has a frontage on Sutter Street of 103′ 1½″ by a depth of 104′ 1″; also a frontage on Trinity Street of 68′ 9″ by a depth of 60′ 0″, and a piece 58′ 0″x 34′ 11″ with entrance fronting on Hardie Street.

The building is a brick four-story and basement, and the amount of—

Rent for year ending January 4, 1895, was		$45,390 81
Expenses, per memorandum furnished, less taxes		11,087 10
		$34,303 71
Deduct 10% of rentals	$4,539 08	
1½% collecting rent	680 86	
		5,219 94
		$29,083 77

On an investment of $400,000, this will yield an income of 7.27% per annum.

The prospective value of the above properties we leave to the judgment of the Board.

We recommend that the funds acquired under the Wilmerding bequest be invested in one of the above properties.

Regent Martin moved that the foregoing report be referred back to the Finance Committee, including Regents Crocker and Marye, with authority to purchase one of the tracts recommended. [Unanimously adopted September 10, 1895.]

Regent Miller, on behalf of the Finance Committee, stated that the committee had not made the purchase of either of the pieces of property submitted to the Board at the last meeting, for the reason that the agent of the Market Street property was seriously ill, and that authority of the court would be needed before purchase of the property belonging to the Johnson estate could be made.

Regent Miller then stated that a third piece of property had been offered—the Starr King building, a five-story and basement stone and brick building, which will hold two more stories. The building fronts on Geary Street, and was built six years ago, and cost $205,000. Clinton Day was the architect. It is now rented as below:

California Furniture Co. (Cole), ten years' lease (three to run)	$1,200 00	
Wakefield Rattan Co.	525 00	
Gas Fixture Co.	500 00	
	$2,225 00 × 12 =	$26,700 00
Taxes	$3,200 00	
Insurance, $100,000, at 1¼%	1,250 00	
		4,450 00
		$22,250 00

5.56% of price of $400,000.

Regent Miller stated that the building could be purchased for $350,000, and would net about 7%.

On motion of Regent Martin, the proposition was referred to the Finance Committee and Regents Marye and Crocker, with authority to purchase.

Regent Hallidie submitted the report of the Finance and Special Committee in relation to the purchase of real estate, as follows:

Your Finance Committee, with Regents Crocker and Marye, duly received from the Secretary of the Board of Regents the following certified copy of the action of the Board relating to the purchase of certain productive real estate:

I, J. H. C. Bonté, Secretary of the Regents of the University of California, hereby certify that the following is a true copy from the minutes of the meeting of the Board of Regents of date of September 10, 1895:

"Regent Hallidie submitted the following report from the Finance Committee:

"*To the Board of Regents, University of California:*

"On February 11, 1890, the Finance Committee was authorized to negotiate the purchase of productive real estate, to yield not less than 5% per annum.

"On June 14, 1894, the Board added to the Finance Committee, for this special purpose, Regents Crocker and Marye.

"Your committee is now prepared to report in favor of the purchase of either of two pieces of property which it submits to the consideration of the Board.

"First—That piece of property situate at the junction of Market and Pine streets, forming a gore thereon and known as the Sherwood Block, being a four-story and basement brick building having a frontage on Market Street of 178′ 2⅜″, 225′ 9⅛″ on Pine Street, and 49′ 6″ on Front Street, and containing an area of 13,141 square feet.

"Revenue from rentals is, gross per annum		$27,924 00
"Expenses—Engineer	$960 00	
Elevator boy	360 00	
Janitor service	120 00	
Coal	1,200 00	
Insurance	241 00	
		2,881 00
"Net reported income (taxes not considered)		$25,043 00
"Additional deductions made by your committee:		
"Janitor in charge	$600 00	
"Painting and repairs	600 00	
"10% on rentals	2,792 40	
"1½% collecting	418 86	
		4,411 26
"Net income to Regents		$20,631 74

"On an investment of $400,000, this will yield an income of 5.16% per annum.

"Second—That piece of property situate on the north side of Sutter Street, between Montgomery and Kearny streets, about 104 feet east of Kearny, is owned by the Johnson estate, and has a frontage on Sutter Street of 103′ 1½″ by a depth of 104′ 1″, also a frontage on Trinity Street of 68′ 9″ by a depth of 60′ 0″, and a piece 58′ 0″x 34′ 11″ with entrance fronting on Hardie Place.

"The building is a brick four-story and basement, and the amount of—

"Rent for the year ending January 4, 1895, was		$45,390 81
"Expenses, per memorandum furnished, less taxes		11,087 10
		$34,303 71
"Deduct 10% of rentals	$4,539 08	
"1½% collecting rent	680 86	
		5,219 94
"Net income to Regents		$29,083 79

"On an investment of $400,000, this will yield an income of 7.27% per annum.

"The prospective value of the above properties we leave to the judgment of the Board.

"We recommend that the funds acquired under the Wilmerding bequest be invested in one of the above properties.

"Regent Martin moved that the foregoing report be referred back to the Finance Committee, including Regents Crocker and Marye, with authority to purchase one of the tracts recommended. Unanimously adopted."

Given under my hand and the seal of the University of California, this 12th day of September, 1895.

[SEAL]

J. H. C. BONTÉ,
Secretary Board of Regents.

After careful and prolonged investigation, your committee concluded to purchase the property belonging to the Johnson estate, and, on October 3, 1895, made the following offer to the executor of said estate, Mr. Benjamin Bangs, which offer was accepted by him:

To BENJAMIN BANGS, ESQ., *Executor Johnson Estate:*

We, the undersigned, members of the Board of Regents, pursuant to the authority in us vested by resolution passed by the Board of Regents at a meeting of said Board on September 10, 1895, hereby offer three hundred and eighty-five thousand dollars ($385,000) for all that real property situated in the City and County of San Francisco, State of California, described as follows, to wit:

Commencing at a point in the northerly line of Sutter Street, distant thereon one hundred and seventy-one feet ten and one half inches (171′ 10½″) east of the easterly line of Kearny Street, and running thence easterly along the northerly line of Sutter Street one hundred and four feet five and one half inches (104′ 5½″); thence at right angles northerly and parallel to Kearny Street one hundred and three feet one and one half inches (103′ 1½″); thence at right angles easterly and parallel to Sutter Street sixty feet (60′), and to the westerly line of Trinity Street; thence at right angles northerly along said line of Trinity Street sixty-eight feet nine inches (68′ 9″); thence at right angles westerly sixty feet (60′); thence at right angles southerly thirty-four feet four and one half inches (34′ 4½″) thence at right angles westerly one hundred and four feet five and one half inches (104′ 5½″); thence at right angles northerly twenty-five feet (25′); thence at right angles westerly thirty-four feet four and one half inches (34′ 4½″); thence at right angles southerly fifty-eight feet (58′); said last-named line extending along the easterly terminus of Hardie Place as a portion of its distance; thence at right angles easterly thirty-four feet four and one half inches (34′ 4½″); thence at right angles southerly one hundred and four feet one inch (104′ 1″), to the northerly line of Sutter Street at the point of beginning.

The diagram of which tract is hereby attached and made a part of this bid.

Provided, the title to said property is satisfactory, free, and unincumbered.

Respectfully submitted,

ALBERT MILLER,
ISAIAS W. HELLMAN,
CHAS. F. CROCKER,
GEO. T. MARYE, JR.,
Committee.

Dated San Francisco, October 3, 1895.

The foregoing offer is hereby accepted, subject to approval of the Superior Court of the City and County of San Francisco, in probate.

BENJAMIN BANGS,
Executor.

SAN FRANCISCO, October 3, 1895.

Received with the foregoing bid a certified check for twenty-five thousand dollars ($25,000) from the Finance Committee of the Board of Regents.

This sum is to be applied as part of the purchase price for the land described in said bid; provided, the said purchase is consummated according to its terms; and if said purchase is not so consummated then this check is to be returned to said Finance Committee on demand.

BENJAMIN BANGS,
Executor.

Your committee further submits the following opinion of Counsel J. B. Mhoon:

In the Matter of the Title to the Kate Johnson Property, described in the bid therefor made by a Committee of the Board of Regents, October 3, 1895.

SAN FRANCISCO, November 4, 1895.

ALBERT MILLER, ESQ., *Chairman, etc.:*

DEAR SIR: I beg leave to report in the above matter that, in accordance with your suggestion, I caused Messrs. Clement to make a search and abstract of title of said property, a full description of which is contained in the bid made by your committee October 3, 1895, a copy hereto attached, and also on the title-page of the abstract thereof, herewith submitted.

A careful examination of said abstract of title shows the title to said property to have been vested in said Kate Johnson at the time of her death.

It further appears that the executor of said Kate Johnson estate did, by proper proceedings therefor, procure an order of the Superior Court, in probate, confirming the sale of said property to the Regents of the University of California on October 15, 1895, for the sum bid, to wit: $385,000.

I am therefore of the opinion that, upon the payment of this sum to said executor, Benjamin Bangs, and the execution and delivery of the deed to the Regents, the title to said property will vest in the Regents, subject only to the State and municipal taxes for 1895-96.

I suggest that the rents and taxes should be adjusted between the vendor and vendee at this time.

Very respectfully,

(Signed:) JOHN B. MHOON.

Being advised that the Wilmerding bequest cannot be invested in the manner proposed, your committee has caused a sufficient amount of bonds and mortgages to be transferred to the Wilmerding Fund, and the amount realized by said transfer has been appropriated to the purchase of the above property.

Your committee ask that its action in the premises be approved by the Board, and that the purchase be consummated by instructions to the Treasurer that he draw his check for the balance of the purchase money, to wit: $360,000, to the order of Benjamin Bangs, executor of last will of Kate Johnson, deceased, and that the same be delivered to J. B. Mhoon, Counsel of the Board, who shall deliver the same to the said executor on the receipt of a duly executed deed for said property.

Your committee recommends that the foregoing property be received by the Secretary of this Board, and that he continue the present management and make arrangements for the collection of rents and the making of repairs, subject to instruction from the Finance Committee.

Your committee further recommends that the vendor receive the rents due up to the date of the delivery of the deed to the property, and that he pay all taxes due up to said date.

A. S. HALLIDIE,
ALBERT MILLER,
GEO. T. MARYE, JR.,
Finance and Special Committee.

On a call of the ayes and noes, the action of the committee was approved and the recommendations contained in the report of the committee were concurred in. [November 12, 1895.]

62. ANNUAL REPORT OF THE COMMITTEE ON FINANCE AND AUDIT.

To the Honorable Board of Regents of the University of California:

GENTLEMEN: Your Committee on Finance and Audit presents its report under more than ordinary difficulties.

On every hand it is met with demands for financial aid that cannot be granted, and sees every department of the University crippled for the lack of funds.

Under ordinary conditions the growth of the University would be viewed with unmixed satisfaction, but the circumstances which surround this noble institution at the present time are of the gravest moment and demand the thoughtful consideration of this Board and of the Legislature of this State.

The Regents have placed in their hands a trust involving the integrity of the highest institution of learning in the State, and which they are called upon to administer wisely and well. Almost unbounded power is given them, and in the management of this trust they are limited only by the pecuniary resources at their command.

The strong inhibition against debt, their absolute inability to create one, or to incur financial obligations beyond their ability to meet, has always been clearly understood and acknowledged.

Your committee know, and the honorable Board of Regents know, that the affairs of the State University have been managed with care and circumspection; but we also know that the economy exercised has been carried by force of circumstances to the realm of parsimony. Yet in this battle we have fought fairly to maintain the University up to the level of our ideal and to the demands of the children of the State; and we are overwhelmed only by the measure of its success, which comes as a flood in the full gleam of sunshine and embarrasses us by the unparalleled expansion of its educational prosperity.

Your committee has carefully considered ways and means to meet the demands for funds to maintain the institution during the coming year, and until the Legislature grants the relief so much needed.

Unlike many corporations, we cannot issue bonds and thus create a debt, and, as reported by the Committee on Ways and Means, to borrow money on faith at this time is impracticable.

The State provides a means of creating a deficiency by the approval of the Board of Examiners (Act approved March 23, 1893, Statutes of 1893, p. 285), trusting that the Legislature will, upon their recommendation, pass a relief bill. We have tried this once and failed; the Board of Examiners did authorize this Board to create a deficiency, but the Legislature of 1895 voted down the relief bill, and that deficiency still exists.

Now, suppose we had to advance a large amount of money, from what source would it come? The special trust funds placed in our hands for specific purposes? The Consolidated Perpetual Endowment Fund? or any fund the principal of which cannot be touched? It is evident that we cannot do this. Thus, not having any source to obtain funds, we would be in the position of a creditor unable to pay his debts, and the debtors would suffer. And the debtors of the University would not be the merchants who furnish supplies, because they would stop credit, but the gentlemen who are in the employ of the University at a monthly or daily stipend. Are we called upon to do this? Your committee thinks not. It is clearly of the opinion that we must carry on the affairs of the University of the State of California within the limit of its financial means, and to increase those means through the only channel open to us, to wit: the Legislature of the State of California, which originally, by the will of the people, founded and now maintains the University of the State of California.

The Legislature cannot afford and will not permit the University to suffer any more than a conscientious father will permit a dutiful son to suffer under like circumstances.

Having a full knowledge of our resources and absolute control of our expenses, we have no excuse or justification for creating a debt which would bring inconvenience and hardship to the attachés of the University, nor could we justify ourselves before a committee of investigation from the Legislature.

If, on a proper statement of facts before the Legislature, we fail to obtain relief, the consequence will be on their heads. Your committee is firm in the belief that, with a clear statement of the needs of the University, and a showing that all through these straits we have preserved its financial integrity, the members of the Legislature will give a ready ear to our needs and grant us the needed relief.

As a fair and equitable measure we recommend that the Legislature be petitioned to increase the one cent tax, 50%, for it is reasonable to suppose that the taxable property of the State will increase hereafter, but, believing as we do, that the increase will be gradual, that additional income by the above means will be about $55,000 for the first year, which will be sufficient to provide for the current expenses (*i. e.*, salaries and budget) of the University. The demand for additional room for instruction comes from every quarter. While it may be expedient or necessary to provide temporary extra quarters, the time has come when the University of California should be provided with means to erect a building worthy of the name of University and of the State to which it belongs. The demands for increased accommodations have been regretfully denied by your committee, while it has fully realized the pressing necessities of these cases and the thoughtful consideration which caused the demands to be made.

Your committee is of opinion that, after the increase required for current expenses, the Board of Regents should petition the present Legislature for a special appropriation of $500,000 for building purposes to cover two years, and the following Legislature for an equal amount for similar purposes to cover the two following years; so that within four years such a building or buildings can be completed at a cost of $1,000,000; and in the meantime provide accommodations for instruction in cheap and temporary isolated structures.

The Finance Committee desire also to call the attention of the Board to the refusal of the Controller to pay over to the Treasurer of the University the amount due the University on what is known as the "Diverted Fund," being the interest on $79,750 of University funds wrongly diverted from the University to the school fund and which the Legislature, under an Act of March 4, 1881 (See Regents' Manual, p. 67), rectified by electing to pay the University six per cent thereon semi-annually, which amount ($2,392 50) has been received regularly since the date of said Act until the last semester of the last fiscal year. We understand that the Attorney-General claims that there is an imperfection in the title of the Act passed by the last Legislature, providing for the continuance of said payment. We recommend that the Counsel of the Board of Regents be requested to draw up a proper Act and that the Board petition for relief in the matter of the amounts due and unpaid up to the time the proposed Act shall go into effect.

In making up the accounts for the year just closed, it is a pleasure to state that, from several sources, we have received increased income, which has enabled the books to be closed without a deficiency, and with an unexpended balance of $2,310 52. This came from the following sources: Delinquent taxes—unexpectedly large amounts being collected—delinquent railroad taxes under the decision of the Supreme Court, balance on students' deposits, and unexpended balances of department apportionments.

In view of the positive need of this small balance of $2,310 52 to meet necessities in the budget of 1896–97, we recommend that the rule by which the balance on hand at the end of the fiscal year is absorbed in the

Consolidated Perpetual Endowment Fund be suspended and the amount transferred to the General Fund for 1896-97.

The individual members of this committee are of opinion that a material saving could be effected in the laboring force on the grounds and in the buildings in Berkeley, if all the laboring force, including the janitors, were placed under one active, intelligent, and faithful foreman or manager, who, through his familiarity with the direct and practical employment of men, would see that the University, as well as the men under him, would get justice. At the present time there is practically no management, and of this advantage is taken; sanitary conditions are neglected, work shirked, and money wasted.

We recommend that the Committee on Grounds and Buildings report to this Board a practical remedy.

Your committee recognizes the great importance to the State of the outlying Experiment Stations, and realizes that the importance to the State must be great to justify their maintenance out of State funds. The organization and creation of the Experiment Stations were induced by an annual appropriation by Congress of $15,000, and it was supposed that the founding of these outlying permanent experimental stations was intended and required under the Act making that appropriation, and under this impression the Board of Regents authorized their establishment, but the impression was erroneous, and these various stations have to be supported by the funds of the University.

The growth of the University has been much beyond our financial strength. In the founding of the University, the Legislature "builded better than they knew," and have unintentionally left the Regents without the means of carrying forward the work it has laid out. Looking back over periods of five years, we find the facts shown in the following table:

Year.	Number of Attachés.	Annual Salary Roll.	Number of Students at Berkeley.	Number of Students per Attaché.	Cost per Student for Salary Roll.
1870	12	$37,912 67	40	3.3	$947 81
1875	34	66,858 23	237	7	282 10
1880	44	82,586 57	268	6	308 16
1885	47	77,478 00	241	5.1	321 78
1890	86	138,217 44	401	4.7	344 68
1895	146	218,991 85	1,124	7.7	194 83

The relation in percentages in students' attendance at Berkeley over the preceding period, omitting 1870, has been: 1880, 8% increase over 1875; 1885, 10% decrease below 1880; 1890, 69% increase over 1885; 1895, 180% increase over 1890.

It will be observed that the cost of tuition per capita, based on the salary roll, has been decreased from $344 68 in 1890, to $194 83 in 1895, while the number of students per name on the salary roll has been increased from $4\frac{7}{10}$ in 1890 to $7\frac{7}{10}$ in 1895.

Statements have been received from the heads of departments, with schedule of minimum requirements. There are twenty-six such statements on file, and from a careful examination of them, your committee is impressed with the considerate manner in which the demands have been made, influenced, doubtless, by the existing financial stringency.

These demands, which aggregate $94,915 50, the committee has been compelled to reduce $43,891 28.

There are several large items, amounting in the aggregate to over $14,000, for certain machinery, which could very advantageously be diverted to the Wilmerding School, as well as other contemplated expenditures, if that school should be located near the College of Mechanic Arts.

After conference with the Committee on Internal Administration, the committee limited the amount to be expended in salaries of all kinds to the amount stated in the estimate, $236,085 84.

We have found it impracticable to provide for painting the buildings, or for supplying light to the Library or grounds, except six arc lights to be judiciously distributed on the grounds.

It is impossible in this report, which is already too long, to enumerate the items denied, and after several meetings, day and evening, we beg to submit the following statement of estimated income and expenditures for the year ending June 30, 1897.

A. S. HALLIDIE,
ALBERT MILLER,
ERNST A. DENICKE,
Committee on Finance and Audit.

ESTIMATED INCOME FOR THE YEAR ENDING JUNE 30, 1897.

Interest on State bonds	$45,060 00	
Interest on San Francisco Park and Avenue Improvement bonds	3,000 00	
Interest on San Francisco Improvement bonds	60 00	
Interest on Fresno County bonds	875 00	
Interest on Plumas County bonds	300 00	
Interest on Kern County bonds	1,050 00	
		$50,345 00
Interest on mortgages		76,920 69
Interest from savings banks (Wilmerding Endowment, $15,000 at 4¼%)		637 50
Rent from cottages	$1,104 00	
Rent from Palmer House	720 00	
		1,824 00
Students' Deposits—		
Chemical Laboratory	$4,500 00	
Mining Laboratory	300 00	
Physical Laboratory	2,000 00	
Biological Laboratory	200 00	
Agricultural Laboratory	50 00	
Botanical Laboratory	50 00	
Civil Engineering	200 00	
Gymnasium lockers	500 00	
		7,800 00
State University Fund, one cent tax		112,607 70
Income from Johnson Building, $385,000 at 6%		23,100 00
Morrill College Aid Fund		22,000 00
Agricultural Experiment Station Fund		15,000 00
State appropriation (Forestry)	$2,500 00	
State appropriation (Viticulture)	2,500 00	
		5,000 00
Phebe Hearst Scholarships		3,600 00
C. F. Crocker, donation for eclipse		800 00
Consolidated Perpetual Endowment Fund awaiting investment, $77,793 19; one half at 6%	2,333 79	
Special Funds awaiting investment, $10,213 41; one half at 6%	306 40	
		2,640 19
Unexpended balances of apportionments for year 1895-96		2,310 52
		$324,585 60
LESS—		
Wilmerding Endowment	$23,137 50	
Tompkins Endowment	1,374 48	
Medal Fund	86 32	
Walton Memorial Loan Fund	11 80	
Special Funds awaiting investment	306 40	
		24,916 50
		$299,669 10

SALARY ROLL PER MONTH.

Administration.

Martin Kellogg	President	$666 66
J. H. C. Bonté	Secretary and Land Agent	275 00
W. A. McKowen	Assistant Secretary and Bookkeeper	125 00
John B. Mhoon	Counsel for Board of Regents	150 00
W. H. Phipps	Clerk	125 00
Rebecca Meyerstein	Stenographer and Typewriter	56 00
Grace Love	Stenographer and Typewriter	30 00
John J. Herr	Auditor	25 00
James Sutton	Recorder	116 66
H. A. Overstreet	Clerk to the Recorder	50 00
Wm. D. Armes	Secretary University Extension Committee	25 00
John Hart	Janitor of Mining and Civil Eng. Building	60 00
John Maison	Janitor of North Hall	60 00
James Tait	Janitor of North Hall	60 00
William Ellis	Janitor of South Hall	60 00
T. R. Elliott	Janitor of Gymnasium	60 00
Volney H. Craig	Janitor of Library Building	40 00
Robert Thompson	Janitor of Agricultural Exp. Station Building	30 00
Robert Dugan	Janitor of Chemical Laboratory Building	60 00
A. M. Niver	Janitor of Mech. and Elect. Building	60 00
H. J. White	Assistant Janitor of South Hall	15 00
J. Mitchell	Armorer	40 00
D. W. Gilbert	Policeman	60 00
James Carpenter	Night Watchman	60 00
W. E. Hadley	Carpenter	75 00
E. Ehret	Plumber	70 00
Benj. Bangs	Agent Johnson Building	100 00
J. C. Layton	Engineer	85 00
John Kusel	Janitor	75 00
R. H. Jones	Elevator Boy	30 00
Gus. Leveque	Freight Elevator Boy	26 00
		$2,770 32

Professors.

F. Slate	Physics	$250 00
Joseph Le Conte	Geology and Natural History	333 33
Irving Stringham	Mathematics	275 00
E. E. Brown	Science and Art of Teaching	250 00
Frank Soulé	Civil Engineering and Astronomy	275 00
W. B. Rising	Chemistry	250 00
E. W. Hilgard	Agriculture and Director of Agr. Exp. Stations	333 33
C. M. Gayley	English Language and Literature	250 00
E. B. Clapp	Greek Language and Literature	250 00
Bernard Moses	History and Political Science	300 00
F. G. Hesse	Mechanical Engineering	275 00
A. Putzker	German Language and Literature	250 00
S. B. Christy	Mining and Metallurgy	250 00
W. A. Setchell	Botany	250 00
W. A. Merrill	Latin Language and Literature	250 00
Wm. Carey Jones	Jurisprudence	225 00
F. V. Paget	French and Spanish Languages	225 00
C. B. Bradley	Rhetoric	225 00
		$4,716 66

Associate Professors.

Geo. C. Edwards	Mathematics	$200 00
Thomas R. Bacon	European History	200 00
Isaac Flagg	Classical Philology	200 00
Andrew C. Lawson	Mineralogy and Geology	200 00
M. W. Haskell	Mathematics	175 00
Geo. M. Richardson	Classical Archæology	50 00
H. T. Ardley	Decorative and Industrial Art	166 66
A. F. Lange	English Philology	150 00
Edmond O'Neill	Organic and Physiological Chemistry	175 00
		$1,516 66

Assistant Professors.

Wm. D. Armes	English Literature	$125 00
Hermann Kower	Instrumental Drawing	150 00
J. H. Senger	German	150 00
A. O. Leuschner	Astronomy and Geodesy	75 00
T. P. Bailey, Jr.	Science and Art of Teaching	125 00
Clarence L. Cory	Mechanical Engineering	166 66
W. E. Ritter	Biology	150 00
Carl C. Plehn	History and Political Science	175 00
H. I. Randall	Civil Engineering	125 00
L. T. Hengstler	Mathematics	100 00
J. C. Rockwell	Classical Archæology	116 66
E. P. Lewis	Physics	125 00
W. J. Raymond	Physics	125 00
L. D. Syle	English Literature	125 00
		$1,833 32

Instructors.

W. J. Sharwood	Chemistry	$100 00
Clifton Price	Latin	100 00
K. C. Babcock	History	83 33
Clive Day	History	83 33
E. H. Simonds	Assaying, and Mill Assistant	83 33
A. B. Pierce	Mathematics	100 00
E. R. Drew	Physics	100 00
E. A. Hersam	Metallurgy, and Analytical Assistant	112 50
W. J. v. Osterhout	Botany	100 00
Geo. M. Stratton	Psychology	125 00
C. S. H. Howard	French	100 00
Gustave E. Faucheux	French	100 00
B. R. Maybeck	Drawing	75 00
L. F. Chesebrough	Mechanic Arts, and in charge of Machine Shops	112 50
T. F. Sanford	English	125 00
E. B. McGilvary	Logic	125 00
W. C. Blasdale	Chemistry	65 00
J. N. Le Conte	Mechanics	75 00
J. C. Merriam	Palæontology	100 00
W. M. Hart	English	83 33
W. L. Jepson	Botany	75 00
J. H. Gray, Jr.	Chemistry	60 00
F. H. Seares	Astronomy	75 00
		$2,158 32

Department Assistants.

Charles Gilman	Assistant in Chemistry	$60 00
S. A. Moss	Student Assistant in Mechanics	20 00
Ira Currier	Machinist and Fireman	75 00
G. E. Cox	Assistant in Wood-working	70 00
G. F. Reinhardt	Student Assistant in Physical Culture	30 00
Henry Ongerth	Reader in German	25 00
W. R. Stamper	Mechanician	100 00
R. R. Rogers	Assistant in Chemistry	50 00
Oscar Schober	Assistant in Mechanics	83 33
Frank Richards	Helper in Metallurgical Laboratory	70 00
C. P. Nott	Assistant in Botany	50 00
A. C. Alexander	Assistant in Physics	75 00
Arthur Incell	Assistant in Physics	50 00
Arthur L. Jordan	Student Assistant in Physics	25 00
L. E. Hunt	Assistant in Civil Engineering	80 00
H. B. Torrey	Assistant in Biology	37 50
Eugene Pitcher	Assistant in Latin	10 42
W. W. Fogg	Assistant in Field Practice	70 00
H. H. Hirst	Assistant in Civil Engineering	16 66
R. J. de Lapierre	Assistant in French	50 00
Walter H. Graves	Reader in Latin	7 50
R. Weiler	Assistant in German	25 00
J. B. Davy	Assistant in Botany	60 00
J. T. Allen	Reader in Greek.	8 33
W. H. Lozier	Fireman	60 00
		$1,208 74

Museum.

H. P. Johnson	Assistant Professor of Biology	$62 50

Library.

J. C. Rowell	Librarian	$200 00
J. D. Layman	Assistant Librarian	100 00
C. K. Jones	Second Assistant Librarian	65 00
		$365 00

Physical Culture.

Walter E. Magee	Director of Physical Culture	$141 66
F. H. Payne	Medical Examiner of men	29 83
Mary B. Ritter	Medical Examiner of women	20 03
Genevra E. Magee	Assistant in Physical Culture	75 00
		$266 52

Lick Astronomical Department.

E. S. Holden	Director and Astronomer	$416 66
J. M. Schaeberle	Astronomer	200 00
W. J. Hussey	Astronomer	166 66
W. W. Campbell	Astronomer	200 00
R. H. Tucker	Astronomer	166 66
A. L. Colton	Assistant Astronomer	100 00
R. G. Aitken	Assistant Astronomer	66 66
C. D. Perrine	Secretary	110 00
J. McDonald	Machinist	83 33
J. L. Bane	Carpenter	75 00
W. W. Pauli	Janitor	60 00
W. N. Jess	Laborer	60 00
Paul Soto	Laborer	30 00
N. D. Soto	Laborer	35 00
		$1,769 97

Agricultural Department.

E. J. Wickson	Associate Professor Agriculture, Horticulture, and Entomology	$200 00
R. H. Loughridge	Assistant Professor Agriculture, Geology, and Agricultural Chemistry	166 66
M. E. Jaffa	Instructor in Agricultural Laboratory	145 83
Geo. E. Colby	Instructor in Viticultural Laboratory	125 00
C. W. Woodworth	Assistant Professor of Entomology	150 00
Arthur P. Hayne	Instructor in Viticulture	125 00
E. Kellner	Gardener to College of Agriculture	75 00
C. H. Shinn	Inspector of Stations	150 00
A. V. Stubenrauch	Foreman Southern Coast Range Station	75 00
George Hansen	Foreman Foothill Station	75 00
Julius Forrer	Foreman San Joaquin Valley Station	75 00
J. W. Mills	Foreman South California Station	75 00
J. H. Barber	Foreman Santa Monica Forestry Station	50 00
A. B. Boland	Foreman Chico Forestry Station	60 00
Wm. Winterhalter	Clerk to Director of Agricultural Exp. Stations	60 00
F. T. Bioletti	Cellarman	83 33
		$1,690 82

Fellows.

W. S. T. Smith	Mineralogy	$41 66
Edgar L. Hinman	Philosophy	50 00
A. V. Saph	Mathematics	50 00
W. H. Wright	Mathematics	50 00
Frank H. Dunn	Pedagogy	50 00
		$241 66

Phebe A. Hearst Scholarships.

Laura Frank	$30 00
Stella Young	30 00
Edna Robinson	30 00
Stella Pierce	30 00
Amanda Krenz, ½ year—Lily Hohfeld, ½ year	30 00
Lucy W. Williams	30 00
Katherine Lynch	30 00
Ida A. Knall	30 00
Jacqueline K. Newton	30 00
Jessie W. Dewell	30 00
Anna M. Landstrom	30 00
Thirmuthis Brookman	30 00
	$360 00

University Printing Office.

Joseph W. Flinn	Superintendent	$100 00
James Gillick	Assistant	30 00
		$130 00

D. O. Mills Endowment

Geo. H. Howison	Professor of Intellectual and Moral Philosophy	$333 33

Edward Tompkins Endowment.

John Fryer	Agassiz Professorship of Oriental Languages	$250 00

Recapitulation.

Administration	$2,770 32
Professors	4,716 66
Associate Professors	1,515 66
Assistant Professors	1,833 32
Instructors	2,158 32
Department Assistants	1,208 74
Library	365 00
Museum	62 50
Physical Culture	266 52
Lick Astronomical Department	1,769 97
Agricultural Department	1,690 82
Fellows	241 66
Phebe A. Hearst Scholarships	360 00
University Printing Office	130 00
D. O. Mills Endowment	333 33
Edward Tompkins Endowment	250 00
Total	$19,673 82

$19,673 82 × 12 = $236,085 84.

ESTIMATED EXPENDITURES FOR YEAR ENDING JUNE 30, 1897.

	Amount Desired by Heads of Departments.	Amount Appropriated.	
Salaries as per salary roll			$236,085 84
Budget, General Fund, and Reese Fund.			
Fuel	$1,800 00	$1,500 00	
Equipment	2,500 00	2,000 00	
Repairs (including sanitation, $500)	2,500 00	2,000 00	
Advertising and printing	150 00	150 00	
Telegraphing and expressage	500 00	500 00	
Stationery	350 00	350 00	
Diplomas	300 00	300 00	
Postage	600 00	600 00	
Official and lecturing expenses (examination of High Schools)	1,500 00	1,500 00	
Water	3,000 00	3,000 00	
Agriculture—Current expenses $5,000 Farmers' Institutes 3,500	8,500 00	8,500 00	
Civil Engineering	4,610 00	1,500 00	
Drawing	150 00	150 00	
Chemistry (including Summer School, $150)	6,110 00	4,500 00	
Mechanics	14,665 00	1,500 00	
Mining	5,450 00	1,000 00	
Lick Observatory	5,500 00	5,500 00	
Military (including insurance on U. S. arms)	4,463 00	500 00	
Mineralogy	1,190 00	300 00	
Physics (including Summer School, $150)	2,400 00	1,500 00	
Physical Culture	902 50	500 00	
Library (Reese Fund)	6,030 00	3,000 00	
Museum	1,250 00	250 00	
Printing Office	700 00	650 00	
University Site	5,000 00	3,000 00	
Botany—Current expenses $500 Laborers 1,800	2,700 00	2,300 00	
Biology	800 00	500 00	
Astronomy	600 00	300 00	
Decorative and Industrial Art	1,300 00	250 00	
Greek	175 00	100 00	
Latin	350 00	200 00	
Philosophy	1,250 00	1,000 00	
Operating electric plant—Light, 6 lamps $360 Power 285	3,400 00	645 00	
Grading and macadamizing College Way		1,479 22	
Pedagogy			
Jurisprudence	300 00		
History and Political Science	800 00		
Mathematics			
German	1,620 00		
French	1,200 00		
English	300 00		
	$94,915 50	$51,024 22	$51,024 22
			$287,110 06

MORRILL COLLEGE AID FUND.

(Included in Salary Roll and Budget.)

Agriculture.		
R. H. Loughridge	$2,000 00	
M. E. Jaffa	1,750 00	
G. E. Colby	1,450 00	
C. W. Woodworth	1,800 00	
		$7,000 00
Chemistry.		
J. H. Gray. Jr	$720 00	
W. C. Blasdale	780 00	
		1,500 00

Civil Engineering.		
Henry T. Ardley	$1,890 00	$1,890 00
Mechanics.		
C. L. Cory	$2,000 00	
Oscar Schober	1,000 00	
J. N. Le Conte	900 00	3,900 00
Mining.		
E. A. Hersam	$1,350 00	
Frank Richards	840 00	2,190 00
Botany.		
W. J. V. Osterhout	$1,200 00	
C. P. Nott	600 00	
J. B. Davy	720 00	
Laborers	1,800 00	4,320 00
Physics.		
W. R. Stamper	$1,200 00	1,200 00
		$22,000 00
U. S. Appropriation for year 1896–97		22,000 00

AGRICULTURAL EXPERIMENT STATION FUND.

Group 1—Salaries (included in salary roll)	$6,380 00	
Group 2—Labor	$4,000 00	
Building and repairs	750 00	$4,750 00
Group 3—Publications	$150 00	
Postage and stationery	250 00	
Freight and expressage	350 00	
Traveling	750 00	1,500 00
Group 4—Seeds, plants, and sundry supplies	$800 00	
Feeding-stuffs	200 00	
Tools, implements, and machinery	350 00	
Furniture and fixtures	100 00	
Live stock	100 00	1,550 00
Group 5—Chemical supplies	$200 00	
Library	100 00	
Scientific apparatus	200 00	
Fertilizers	100 00	
Heat, light, and water	100 00	700 00
Group 6—Contingent expenses	$120 00	120 00
		$8,620 00

STATE APPROPRIATION (VITICULTURE).

Salary (included in salary roll), $650.		
Postage and stationery	$100 00	
Books and periodicals	50 00	
Traveling expenses	450 00	
Labor	450 00	
Freight and expressage	75 00	
Investigations in the country at vineyards	75 00	
Purchase and distribution of resistant vines	150 00	
Apparatus and repairs	300 00	
Incidentals	100 00	1,750 00
University Medal Fund	$125 00	
Walton Memorial Loan Fund	125 00	250 00

STATE APPROPRIATION (FORESTRY).

Salaries (included in salary roll), $1,320.		
Labor	$750 00	
Supplies (including blacksmithing)	250 00	
Postage and stationery	30 00	
Freight and expressage	50 00	
Traveling expenses	100 00	
		$1,180 00
		$299,010 06

A. S. HALLIDIE,
ALBERT MILLER,
ERNST A. DENICKE,
Committee on Finance and Audit.

RÉSUMÉ.

Estimated income	$299,669 10
Estimated expenditures	299,010 06
Estimated surplus	$659 04

REQUESTS BY HEADS OF DEPARTMENTS FOR FISCAL YEAR 1896-97.

1. AGRICULTURE—		
Budget	$5,000 00	
Farmers' Institutes	500 00	
		$5,500 00
2. CIVIL ENGINEERING—		
Lecturer on Water Supply and Sanitary Engineering	$1,000 00	
Increase of H. I. Randall's salary	300 00	
H. H. Hirst, Assistant in Civil Engineering	600 00	
L. E. Hunt, increase from $840 to $1,200	360 00	
Budget	1,600 00	
Surveying instruments	750 00	
		4,610 00
3. CHEMISTRY—		
Fellow in Chemistry	$250 00	
C. Gilman, W. J. Sharwood, and W. C. Blasdale; increase of $10 per month in each salary	360 00	
Budget	5,500 00	
		6,110 00
4. MECHANICS—		
New appointment and increases	$3,150 00	
Necessary expenditures	11,515 00	
		14,665 00
Lighting grounds	$1,725 00	
Lighting Library	1,440 00	
Power system	285 00	
		3,450 00
5. MINING—		
Budget	$5,000 00	
E. A. Hersam, restored to $1,500	250 00	
E. H. Simonds, restored to $1,200	200 00	
		5,450 00
6. MILITARY DEPARTMENT—		
Increase in Armorer's pay from $480 to $720	$240 00	
Other items	4,223 00	
		4,463 00
7. GEOLOGY AND NATURAL HISTORY—		
Mineralogy—		
Increase of A. C. Lawson's salary	$300 00	
Microscopes	500 00	
Publications, Geology	300 00	
Palæontological charts	90 00	
		1,190 00
Museum—		
Increase of H. P. Johnson's salary	$750 00	
Budget	500 00	
		1,250 00
Diagrams for Prof. Le Conte and Prof. Ritter	$300 00	
		300 00

8. Physics—		
Budget	$2,000 00	
Student Assistant	300 00	
Increase in Dr. Alexander's salary	100 00	
		$2,400 00
9. Physical Culture—		
Budget	$902 50	
Assistant Mrs. Magee, increase to $900	505 00	
		1,407 50
10. Library—		
Periodicals	$1,000 00	
Binding books and periodicals	1,000 00	
Freight	100 00	
Postage	75 00	
Supplies	50 00	
Increase of J. D. Layman's salary	300 00	
Increase of C. K. Jones' salary	120 00	
Student Assistant, nine months for evening work	315 00	
Janitor, increase of salary	120 00	
Reese Fund	3,000 00	
		6,030 00
11. Printing Office—		
Paper, type, etc.	$500 00	
Steam-fitting and motor	200 00	
		700 00
12. Botany—		
Budget	$700 00	
Building galleries for herbarium	200 00	
Laborers	1,800 00	
		2,700 00
13. Astronomy—		
F. H. Seares, $900; F. E. Ross, $600	$300 00	
Prof. Leuschner, leave one year, one-half pay		
Budget	300 00	
		600 00
15. Industrial Arts—		
Assistant	$1,000 00	
Budget	300 00	
		1,300 00
16. Greek—		
Reader	$75 00	
Budget	100 00	
		175 00
17. Latin—		
Increase of Instructor Price's salary	$100 00	
Assistant and reader in Latin	250 00	
		350 00
18. Philosophy—		
Increase of Mr. Stratton's salary	$900 00	
Budget	1,250 00	
		2,150 00
19. Pedagogy—		
Increase of Prof. Bailey's salary		
Appointment of new man		
Contingent Fund		
20. Jurisprudence—		
Increase of Prof. Jones' salary	$300 00	
Books		
Instructor		
		300 00
21. History and Political Science—		
Fellowship	$600 00	
Increase of C. Day's salary	200 00	
		800 00
22. Mathematics—		
23. German—		
Increase of Ongerth's salary	$120 00	
Increase of Weiler's salary (work increased)	300 00	
New Instructor	1,200 00	
		1,620 00
24. French—		
Salary of Professor increased from $2,700 to $3,000	$300 00	
Salary of Assistant Professor, $1,200 to $1,500	300 00	
Assistant promoted to Instructor	600 00	
		1,200 00

25. ENGLISH—		
Increase of Lange's salary	$300 00	
		$300 00
26. DRAWING—		
Budget	$150 00	
Increase of B. R. Maybeck's salary	300 00	
		450 00

UNEXPENDED BALANCES OF APPORTIONMENTS FOR THE YEAR 1895-96.

(Estimated.)

Fuel	$43 61	
Repairs, $125; equipment, $250	375 00	
Advertising and printing	200 00	
Stationery	40 00	
Water	225 00	
Civil Engineering	20 00	
Mechanics, $30; mining, $10	40 00	
Lick Observatory	17 16	
Physical Culture	20 00	
University Extension	100 00	
Drawing	6 00	
Astronomy	20 00	
Reservoir Site	93 75	
Greek, $55; Latin, $60	115 00	
Philosophy	995 00	
		$2,310 52

Regent Hallidie, Chairman of the Finance Committee, submitted the following:

The individual members of this committee are of opinion that a material saving could be effected in the laboring force on the grounds and in the buildings in Berkeley, if all the laboring force, including the janitors, were placed under one active, intelligent, and faithful foreman or manager, who, through his familiarity with the direct and practical employment of men, would see that the University, as well as the men under him, would get justice. At the present time there is practically no management, and of this advantage is taken; sanitary conditions are neglected, work shirked, and money wasted. We recommend that the Committee on Grounds and Buildings report to this Board a practical remedy. [Concurred in July 14, 1896.]

Regent Hallidie, Chairman of the Finance Committee, submitted the following:

In making up the accounts for the year just closed, it is a pleasure to state that, from several sources, we have received increased income which has enabled the books to be closed without a deficiency, and with an unexpended balance of $2,310 52. This came from the following sources: Delinquent taxes—unexpectedly large amounts being collected—delinquent railroad taxes under the decision of the Supreme Court, balance on students' deposits, and unexpended balances of department apportionments. In view of the positive need of this small balance of $2,310 52, to meet necessities in the budget of 1896–97, we recommend that the rule by which the balance on hand at the end of the fiscal year is absorbed in the Consolidated Perpetual Endowment Fund be suspended and the amount transferred to the General Fund for 1896–97. [Concurred in, on a call of the ayes and noes, July 14, 1896.]

63. Report of the Auditor.

Berkeley, Cal., July 1, 1896.

A. S. Hallidie, Esq., *Chairman of the Finance and Auditing Committee of the Board of Regents of the University of California:*

Sir: I have audited the books and accounts of the Regents of the University of California (in their office in Berkeley, Cal.), consisting of the "General Books of Accounts," the Agricultural Experiment Stations, the Morrill College Aid Fund, for the fiscal year beginning July 1, 1895, and ending June 30, 1896 (the examinations were made monthly), and find them correct.

Vouchers, incurred through requisitions and orders, properly examined and checked with the orders, approved by proper committees, approved and purchase ordered by the Finance Committee, allowed by the Auditing Committee, ordered paid by the Board of Regents, as shown in the minutes of their proceedings, and receipted, are on file for all payments as charged in the cash book during above period.

All moneys received by the Secretary for rents, sale of wood at Lick Observatory, sale of publications and material, returns on vouchers, students' deposits, payment on land, etc., have been paid to the Treasurer and appear in his accounts.

All checks drawn by the Secretary on the Treasurer for returns on students' deposits, check and agree with payment of same by the Treasurer.

Examined the Treasurer's monthly statements rendered during above period, and find them correct and agreeing with the Regents' books.

The statements, rendered by Benjamin Bangs, agent for the Johnson property, of rents and expenses, are correct.

Herewith please find trial balance of the general ledger to July 1, 1896.

Respectfully submitted.

J. J. Herr,
Auditor.

Statement of the Consolidated Perpetual Endowment Fund of the University of California.

1896—April 28—By balance per last statement		$1,928,327 15
April 30—By rent of land in Kern County		40 00
May 31—By land principal, certificate No. 2551		400 00
June 30—By diploma fees to date		1,460 00
June 30—By interest from San Francisco Savings Union to June 30, 1896		13 37
June 30—By interest from Security Savings Bank to June 30, 1896		23 48
		$1,930,264 00
Invested as follows:		
In bonds	$766,500 00	
In mortgages	569,650 21	
In Johnson property	385,000 00	
In State of California, Diverted Fund	79,750 00	
In savings banks	110 60	
In cash with Treasurer	129,253 19	
		$1,930,264 00

Statement for the Fiscal Year ending June 30, 1896.

Disbursements.		Receipts.	
College of—			
Agriculture	$17,071 41	Interest on bonds	$48,512 80
Chemistry	19,616 35	Interest on mortgages	46,771 23
Civil Engineering	15,259 99	Interest on diverted fund	2,392 50
Letters	25,687 72	Land patent fees	32 00
Mechanics	21,177 47	Rent Bailey tract	30 00
Mines	10,559 61	Sale of wood, publications, old type, oil-cans, etc.	
Social Sciences	23,908 81		470 74
Natural Sciences	13,429 06	Premium Mechanics' Fair	10 00
Department of—		Tests in Civil Engineering Laboratory	
Lick Observatory	20,408 91		12 00
Biology	532 33	Rebate on freight, etc.	9 75
Military	628 54	Rent Palmer House	555 81
Mineralogy	692 94	Rent of cottages	1,104 00
Physics	967 33	Students' deposits	8,245 24
Physical Culture	3,693 05	Johnson building	22,855 26
Drawing	244 05	Tax one-cent fund	112,543 56
Greek	26 46		
Latin	109 95		
Mathematics	28 94		
Decorative and Industrial Art	299 89		
Astronomy	279 83		
Philosophy	4 97		
Botany	508 08		
Administration	44,368 62		
Library	5,578 34		
Museum	1,290 61		
University Site improvement	5,071 04		
University Printing Office	2,159 43		
Propagating-House	2,355 04		
Johnson building	6,402 75		
Revenue account	30 96		
	$242,392 48		
Net credit balance for year	1,152 41		
Total disbursements	$243,544 89	Total receipts	$243,544 89

Revenue Account.

Balance		$15,263 82	June 30, 1896—By balance	$15,263 82
Less—				
Interest accrued to June 30, '96, not paid	$12,990 11			
Net balance of previous year	1,121 30			
		14,111 41		
Net credit balance for year		$1,152 41		

Statement of Securities belonging to the University of California.

Mortgages	$1,143,000 00
State, County, and City bonds	856,500 00
State of California, Diverted Fund	79,750 00
	$2,079,250 00

Statement of Fund Accounts.

Consolidated Perpetual Endowment Fund—	
Mortgages	$569,650 21
Bonds	766,500 00
Johnson property	385,000 00
State of California, Diverted Fund	79,750 00
Cash in Treasurer's hands	129,253 19
Savings Banks	110 60
	$1,930,264 00
Lick Observatory Fund—	
Bonds	$90,000 00
Cash, Treasurer	18 16
	$90,018 16
Edward Tompkins Endowm't—	
Mortgages	$42,871 72
Cash, Treasurer	513 52
	$43,385 24
D. O. Mills Endowment—	
Mortgages	$100,000 00

J. Clute Wilmerding Endowment—	
Mortgages	$375,000 00
Savings Banks	15,000 00
Cash, Treasurer	10,000 00
	$400,000 00
Michael Reese Library Fund—	
Mortgages	$50,000 00
F. J. Walton Memorial Loan Fund—	
Mortgages	$1,955 05
Cash, Treasurer	138 40
	$2,093 45
University Medal Fund—	
Mortgages	$3,523 02
Cash	216 70
	$3,739 72
P. Charles Cole Scholarship—	
Cash with Treasurer	$1,000 00

[On file October 13, 1896.]

V. REPORT OF THE LAND AGENT.

To the Honorable Board of Regents of the University of California:

Gentlemen: I have the honor to submit the report of the Land Agent for the year ending June 30, 1896.

Receipts for the Fiscal Year ending June 30, 1896.

From sales of the grant of 150,000 acres	$5,600 00
From fees for filing land patents	26 00
From fees due Secretary of State for affixing seal to patents	10 00
Total receipts	$5,636 00

Account with the Congressional Land Grant of 150,000 Acres.

Whole number of acres patented to June 30, 1895	140,644.14
Total number of acres patented from June 30, 1895, to June 30, 1896	1,528.52
Total number of acres patented to June 30, 1896	142,172.66
Total number of acres outstanding bearing interest	520.00
Total number of acres full paid awaiting patent	425.89
Total number of acres patent fees delinquent	240.00
Sold and patented by State Register	204.78
Remaining unsold (abandoned)	6,355.96
Total number of acres listed to the grant of 150,000 acres	149,919.29
Total amount of principal outstanding of the grant of 150,000 acres	$2,080 00

Receipts from Sale of the Congressional Land Grant of 150,000 Acres.

Total amount cash received	$727,909 20
Total amount outstanding	2,080 00
Total	$729,989 20
Average price per acre	$5 01+

Statement of Patents Issued.

Total number of Patents issued from April 29, 1872, to June 30, 1895 886

				Minimum.		Double Minimum.	
				Area Patented.	Area Accepted by State.	Area Patented.	Area Accepted by State.
Total number acres patented from April 29, 1872, to June 30, 1895				88,584.70	89,123.14	51,156.84	51,520.00
Statement of Patents issued from June 30, 1895, to June 30, 1896.							
Date of Patent.	No. of Patent.	No. of Location.	Name of Patentee.				
1895.							
July 30	867	1774	John Boggs			40.00	40.00
July 30	868	1776	Pomona Land and Water Co.			128.03	128.03
July 30	869	1758	Pomona Land and Water Co.			160.49	160.49
Nov. 4	870	1469	W. F. Goad and A. W. Foster, trustees of Annie A. and Hazel G. Montgomery			10.78	40.00
Dec. 31	871	1790	M. D. Hyde, assignee of N. K. Mastin	36.06	40.00		
1896.							
Mar. 21	872	1280	Carson and Tahoe Lumber and Milling Co.	1,040.00	1,040.00		
May 15	873	1733	Mann Bros.	40.00	40.00		
May 15	874	1734	Mann Bros.	40.00	40.00		
				89,740.76	90,283.14	51,496.14	51,888.52

Total area minimum lands patented	89,740.76
Total area double minimum lands patented	51,496.14
Total area patented to June 30, 1896	141,236.90
Total area minimum lands accepted by State	90,283.14
Total area double minimum lands accepted by State	51,888.52
	142,171.66

University Lands for Sale.

No. of Location.	Description.	Section	Township	Range	Area.	Meridian.
	Monterey County.					
1105	E. ½ of S.E. ¼, N.W. ¼ of S.E. ¼, N.E. ¼ of S.W. ¼	22	24 S.	16 E.	160.00	Mount Diablo.
1107	W. ½ of N.W. ¼	26	24 S.	16 E.	80.00	Mount Diablo.
1378	N. ½ of N.E. ¼, N.E. ¼ of S.E. ¼, S.W. ¼ of S.E. ¼	32	24 S.	9 E.	160.00	Mount Diablo.
	Tulare County.					
797	N. ½ of S.E. ¼	28	24 S.	17 E.	80.00	Mount Diablo.
1106	S.E. ¼ of N.E. ¼	10	24 S.	16 E.	40.00	Mount Diablo.
	Mendocino County.					
707	S.E. ¼ of N.W. ¼	29	14 N.	16 W.	40.00	Mount Diablo.
1337	W. ½ of Lot 5	3	12 N.	12 W.	40.00	Mount Diablo.
1020	N.W. ¼ of S.E. ¼	22	14 N.	16 W.	40.00	Mount Diablo.
1473	S.E. ¼ of S.W. ¼	22	13 N.	13 W.	40.00	Mount Diablo.
1472	Lot 7	6	11 N.	11 W.	40.00	Mount Diablo.
1577	Lot 5	12	17 N.	14 W.	40.00	Mount Diablo.
1578	Lot 7	12	17 N.	14 W.	40.00	Mount Diablo.
1461	S.W. ¼ of N.E. ¼ and S.W. ¼ of S.W. ¼	15	15 N.	13 W.	160.00	Mount Diablo.
	S.W. ¼ of N.W. ¼	22	15 N.	13 W.		
	S.E. ¼ of N.E. ¼	29	15 N.	13 W.		
1477	S.E. ¼ of N.W. ¼	32	16 N.	13 W.	40.00	Mount Diablo.
1479	N.W. ¼ of S.W. ¼	32	16 N.	13 W.	40.00	Mount Diablo.
1721	S. ½ of S.E. ¼	18	16 N.	12 W.	80.00	Mount Diablo.
1700	S.W. ¼ of S.E. ¼	10	15 N.	13 W.	40.00	Mount Diablo.
1680	Lot 10 or N.W. ¼ of S.E ¼	19	17 N.	12 W.	40.00	Mount Diablo.
	San Mateo County.					
1391	W. ½ of N.E. ¼	20	8 S.	4 W.	80.00	Mount Diablo.
	San Benito County.					
975	Lots 3 and 4	4	14 S.	7 E.	80.60	Mount Diablo.
	Fresno County.					
486	S.W. ¼, S.E. ¼ of N.W. ¼, S.W. ¼ of N.E. ¼	9	14 S.	25 E.	240.00	Mount Diablo.
	Kern County.					
22	W. ½	14	11 N.	21 W.	320.00	San Bernardino.
22	N.W. ¼	18	11 N.	21 W.	160.69	San Bernardino.
22	All of Section	22	11 N.	21 W.	640.00	San Bernardino.
22	All of Section	24	11 N.	20 W.	640.00	San Bernardino.
847	N.E. ¼ of N.W. ¼	28	26 S.	17 E.	40.00	Mount Diablo.
788	W. ½	6	11 N.	21 W.	320.80	San Bernardino.
1030	N.E. ¼ of N.E. ¼	4	25 S.	17 E.	41.60	Mount Diablo.
	El Dorado County.					
1466	S.E. ¼ of S.W. ¼	2	9 N.	11 E.	40.00	Mount Diablo.
1467	N.W. ¼ of N.W. ¼	11	9 N.	11 E.	40.00	Mount Diablo.
1467	E. ½ of N.E. ¼, S.W. ¼ of N.E. ¼, E. ½ of N.W. ¼, S.W. ¼ of N.W. ¼, N.W. ¼ of S.W. ¼	10	9 N.	11 E.	280.00	Mount Diablo.
1467	S.E. ¼ of N.E. ¼, E. ½ of S.E. ¼	9	9 N.	11 E.	120.00	Mount Diablo.
1468	E. ½ of S.E. ¼	2	9 N.	11 E.	80.00	Mount Diablo.
1468	N. ½ of N.E. ¼, S.E. ¼ of N.E. ¼	11	9 N.	11 E.	120.00	Mount Diablo.
	Yuba County.					
519	S. ½ of S.W. ¼	20	14 N.	4 E.	80.00	Mount Diablo.
710	S. ½ of S.E. ¼	2	15 N.	5 E.	80.00	Mount Diablo.
	Lassen County.					
771	N.E. ¼ of S.E. ¼	24	27 N.	14 E.	40.00	Mount Diablo.

University Lands for Sale—Continued.

No. of Location.	Description.	Section	Township	Range	Area.	Meridian.
	San Luis Obispo County.					
222	E. ½	6	28 S.	18 E.	295.29	Mount Diablo.
799½	N.E. ¼ of N.E. ¼	25	27 S.	10 E.	40.00	Mount Diablo.
871	N.W. ¼ of N.W. ¼	5	30 S.	11 E.	40.00	Mount Diablo.
1745	S.W. ¼ of S.E. ¼	4	25 S.	9 E.	40.00	Mount Diablo.
1590	E. ½ of S.E. ¼ and Lot 1	4	26 S.	9 E.	128.83	Mount Diablo.
1629	N.W. ¼ of N.E. ¼ (or Lot 2)	4	25 S.	9 E.	47.21	Mount Diablo.
1300	S.W. ¼ of S.W. ¼	14	25 S.	9 E.	40.00	Mount Diablo.
1301	S.W. ¼ of S.W. ¼	34	25 S.	9 E.	40.00	Mount Diablo.
1302	N. ½ of N.E. ¼ and N.E. ¼ of N.W. ¼	20	25 S.	9 E.	120.00	Mount Diablo.
1303	N.W. ¼ of N.E. ¼	34	25 S.	9 E.	40.00	Mount Diablo.
1267	S.E. ¼ of S.E. ¼ and N.W. ¼ of S.E. ¼	14	25 S.	9 E.	520.94	Mount Diablo.
	S.W. ¼ of S.W. ¼	20	25 S.	9 E.		
	S. ½ of N.E. ¼ and N. ½ of N.W. ¼	22	25 S.	9 E.		
	E. ½ of S.E. ¼	28	25 S.	9 E.		
	N.E. ¼ of S.E. ¼ and S.W. ¼ of N.E ¼	32	25 S.	9 E.		
	N.E. ¼ of S.W. ¼ and S.W. ¼ of N.W. ¼	30	25 S.	9 E.		
1299	N.E. ¼ of N.E. ¼	22	25 S.	9 E.	40.00	Mount Diablo.
	Nevada County.					
289	N.E. ¼ of S.E. ¼, S.E. ¼ of N.E. ¼	20	17 N.	12 E.	80.00	Mount Diablo.
	Inyo County.					
1728	S.W. ¼ of S.E. ¼	35	21 S.	42 E.	40.00	Mount Diablo.
1729	N.W. ¼ of N.W. ¼	14	22 S.	42 E.	40.00	Mount Diablo.
	Contra Costa County.					
1418	S. ½ of N.E. ¼	22	1 N.	1 E.	80.00	Mount Diablo.
	Santa Clara County.					
1672	S.W. ¼ of N.E. ¼	18	9 S.	4 E.	40.00	Mount Diablo.
	Glenn County.					
420	N.E. ¼ of N.W. ¼	2	22 N.	4 W.	40.00	Mount Diablo.
					6,355.96	

VI. FINANCIAL AND OTHER STATEMENTS.

1. Value of Property Belonging to the University.

The plant at Berkeley:		
$245\frac{76}{100}$ acres of land at market price of real estate, $4,370 65	$1,069,760 00	
$3\frac{34}{100}$ acres of land, at $1,137 72+	3,800 00	
Buildings	646,792 94	
Apparatus and other contents of buildings	365,000 00	
		$2,085,352 94
Plant at Mount Hamilton		619,925 00
Medical College Building in San Francisco		25,000 00
United States land grant—principal in process of payment		1,760 00
Unsold land—6,355.96 acres, at $5 per acre		31,779 80
Mark Hopkins Institute of Art Building		600,000 00
Miss Mary Jucksch Donation—land valued at		1,000 00
		$3,364,817 74

In addition to the above the Hon. Adolph Sutro has donated $13\frac{43}{1000}$ acres of land in San Francisco, on which there will be erected buildings to cost $250,000.

The foregoing, though very useful and necessary, is non-productive of income.

2. Cash Capital June 30, 1896.

Consolidated Perpetual Endowment Fund.		
Bearing interest	$1,779,010 81	
Cash awaiting investment	129,253 19	
Montgomery Avenue bonds (not bearing interest)	22,000 00	
		$1,930,264 00
Special Funds.		
J. Clute Wilmerding Endowment	$400,000 00	
Hastings College of the Law	100,000 00	
Lick Observatory Fund	90,018 16	
Michael Reese Library Fund	50,000 00	
D. O. Mills Endowment	100,000 00	
University Medal Fund	3,739 72	
Edward Tompkins Endowment	67,907 82	
Frank J. Walton Memorial Loan Fund	2,093 45	
P. Charles Cole Scholarship	1,000 00	
Miss Mary Jucksch Donation	50 00	
		814,809 15
		$2,745,073 15
State tax of one cent on each $100 of value of taxable property of the State, amount received for the year 1895–96 being interest at 5% on		2,250,871 20
		$4,995,944 35

Value of property	$3,364,817 74	
Cash capital	4,995,944 35	
Grand total		$8,360,762 09

3. INVESTMENTS.

Consolidated Perpetual Endowment Fund.

Bonds	$766,500 00	
Mortgages	569,650 21	
Savings bank	110 60	
Diverted funds (held by the State of California)	79,750 00	
Johnson Building	385,000 00	
		$1,801,010 81

Special Funds.

J. Clute Wilmerding Endowment (mortgages)	$375,000 00	
J. Clute Wilmerding Endowment (savings banks)	15,000 00	
Hastings College of the Law	100,000 00	
D. O. Mills Endowment (mortgages)	100,000 00	
University Medal Fund (mortgages)	3,523 02	
Edward Tompkins Endowment (mortgages)	67,394 30	
Michael Reese Library Fund (mortgages)	50,000 00	
Frank J. Walton Memorial Loan Fund (mortgages)	1,955 05	
Lick Observatory Fund (bonds)	90,000 00	
		802,872 37

Cash Awaiting Investment June 30, 1896.

Consolidated Perpetual Endowment Fund	$129,253 19	
J. Clute Wilmerding Endowment	10,000 00	
Edward Tompkins Endowment	513 52	
Frank J. Walton Memorial Loan Fund	138 40	
University Medal Fund	216 70	
Lick Observatory Fund	18 16	
P. Charles Cole Scholarship	1,000 00	
Miss Mary Jucksch Donation	50 00	
		141,189 97
		$2,745,073 15

4. LOANS MADE DURING THE YEAR 1895–96.

W. H. Weilbye, on property in Oakland	$20,000 00
J. N. G. Hunter, on property in San Francisco	20,000 00
John Nicholl, on property in Oakland	48,000 00
Edwin Danforth, on property in San Francisco	20,000 00
	$108,000 00

5. LOANS PAID DURING THE YEAR 1895–96.

J. Lynch, on property in San Francisco	$60,000 00
D. N. Hastings, on property in Solano County	23,000 00
Mrs. U. H. Diel, on property in Oakland	10,000 00
H. R. Miller, on property in Oakland	50,000 00
Mechanics' Institute, on property in San Francisco, on account	10,000 00
C. R. Lewis, on property in Oakland, on account	4,000 00
J. A. Hardin, on property in Mendocino County, on account	4,000 00
Mrs. Fannie McAllis, on property in Oakland, on account	1,000 00
	$162,000 00

6. BONDS REDEEMED DURING THE YEAR 1895–96.

Marin County Railroad Subsidy bonds, Nos. 21 to 70, and 121 to 170, both inclusive	$50,000 00
Plumas County bond, No. 19	1,000 00
	$51,000 00

7. Income for Fiscal Year Ending June 30, 1896.

Available for Current Expenses.

Interest on bonds	$48,512 80
Interest on mortgages	46,771 23
Interest on diverted funds	2,392 50
Land and patent fees, and certified copies of land papers	32 00
Rent of Bailey tract	30 00
Sale of wood at Lick Observatory	232 16
Sale of publications	132 30
Sale of old type	98 40
Rebate on freight, etc.	9 75
Premium from Mechanics' Institute Fair	10 00
Tests in Civil Engineering Laboratory	12 00
Sale of oil cans, etc.	7 88
Rent of Palmer House	555 81
Rent of cottages	1,104 00
Students' Deposits—Chemical Laboratory	4,398 17
Physical Laboratory	2,644 80
Mining Laboratory	315 09
Biological Laboratory	435 00
Agricultural Laboratory	44 00
Civil Engineering Laboratory	347 75
Botanical Laboratory	58 00
Military Department	2 43
Income from Johnson Building	22,855 26
State University Fund, one cent tax	112,543 56
Total	$243,544 89

Special Funds.

Lick Observatory Fund (bonds)	$5,400 00
D. O. Mills Endowment (mortgages)	8,199 40
Edward Tompkins Endowment	3,689 31
University Medal Fund	211 32
Frank J. Walton Memorial Loan Fund	125 40
Michael Reese Library Fund	5,671 09
Agricultural Experiment Station Fund	15,000 00
Morrill College Aid Fund	21,000 00
J. Clute Wilmerding Endowment	13,258 33
Fund for installing Crossley Reflector	500 00
Phebe Hearst Scholarships	3,600 00
State appropriation (Forestry)	3,806 71
State appropriation (Viticulture)	1,131 67
State appropriation (Affiliated Colleges buildings)	2,227 07
C. F. Crocker donation for eclipse expedition	2,500 00
Donation to Department of Astronomy	100 00
Donation for lighting University grounds	1,000 00
Donation for lighting University Library	1,000 00
Total	$88,420 30

Available for current expenses	$243,544 89
Special funds	88,420 30
Total income	$331,965 19

8. Expenditures for the Fiscal Year Ending June 30, 1896.

Salaries	$182,580	51
Fuel	1,456	39
Equipment	1,714	64
Repairs	1,373	02
Advertising and printing	134	45
Telegraphing and expressage	594	70
Stationery	259	25
Postage	603	00
Official and lecturing expenses	1,616	70
Water and purchase of reservoir site	6,672	37
Insurance	162	25
College celebrations	318	50
Publications	37	00
College of Agriculture	5,712	42
College of Chemistry	4,355	06
College of Civil Engineering	2,266	67
College of Mechanics	5,540	56
College of Mining	965	26
Department of Lick Observatory	5,422	66
Department of Biology	532	33
Department of Military Science	628	54
Department of Mineralogy	692	94
Department of Physics	967	33
Department of Physical Culture	463	38
Library	1,198	34
Museum	240	32
Revenue account	30	96
University Site improvement	5,071	04
University Printing Office	599	43
Department of Botany	508	08
Propagating House, Agricultural Department	2,355	04
Department of Drawing	244	05
Department of Greek	26	46
Department of Latin	32	45
Department of Mathematics	28	94
Department of Decorative and Industrial Art	299	89
Department of Astronomy	279	83
Department of Philosophy	4	97
Johnson Building	6,402	75
Total	$242,392	48

Special Funds.

Lick Observatory Fund	$5,400	00
Agricultural Experiment Station Fund	16,327	48
D. O. Mills Endowment	5,499	96
Fund for installing Crossley Reflector	2,487	90
Michael Reese Library Fund (interest)	2,051	54
University Medal Fund	125	00
Morrill College Aid Fund	21,000	00
Phebe Hearst Scholarships	3,600	00
Frank J. Walton Memorial Loan Fund	125	00
State appropriation (Forestry)	2,490	53
State appropriation (Viticulture)	1,910	87
State appropriation (Affiliated Colleges buildings)	608	35
J. Clute Wilmerding Endowment (interest)	334	63
C. F. Crocker donation for eclipse expedition	1,682	53
Donation for Department of Astronomy	100	00
Donation for lighting University grounds	988	85
Donation for lighting University Library	965	75
Hearst donation	100	00
A. Blair Thaw donation	100	00
Total	$65,898	39

From General Fund	$242,392	48
From Special Funds	65,898	39
Total expenditures	$308,290	87

9. STATEMENT OF ALL RECEIPTS AND DISBURSEMENTS FOR THE FISCAL YEAR ENDING JUNE 30, 1896.

Receipts.

Agricultural Experiment Stations Fund	$15,000 00
Bills receivable	162,000 00
Cash on hand June 30, 1895	35,769 59
Consolidated Perpetual Endowment Fund	5,756 40
D. O. Mills Endowment (interest)	8,199 70
Edward Tompkins Endowment	3,689 31
Fund for installing the Crossley Reflector	500 00
Revenue account	103,641 02
Sale of Geological Survey Reports	17 50
Michael Reese Library Fund (interest)	5,671 09
Students' deposits (diplomas)	5,690 00
State University Fund, one cent tax	112,543 56
State Treasurer	51,000 00
State fees	10 00
San Francisco Savings Union	14,000 00
Security Savings Bank	20,598 57
University Medal Fund	211 32
Palmer House	720 00
Morrill College Aid Fund	21,000 00
Rent account	1,104 00
Students' Deposits—Chemical Laboratory	6,958 10
Mining Laboratory	600 00
Physical Laboratory	5,285 55
Library	25 00
Gymnasium lockers	143 50
Biological Laboratory	465 00
Agricultural Laboratory	120 00
Botanical Laboratory	107 50
Military Department	2,994 54
Civil Engineering Laboratory	799 30
Phebe Hearst Scholarships	3,600 00
Frank J. Walton Memorial Loan Fund	125 40
Miss Mary Jucksch donation	30 00
State appropriation (Forestry)	3,806 71
State appropriation (Viticulture)	1,131 67
State appropriation (Affiliated Colleges buildings)	2,227 07
J. Clute Wilmerding Endowment	350,401 43
J. Clute Wilmerding Endowment (interest)	13,258 33
Income from Johnson property	22,855 26
C. F. Crocker donation for eclipse expedition	2,500 00
P. Charles Cole Scholarship	1,000 00
Agricultural Experiment Stations (sale of produce, etc.)	202 51
Donation to Department of Astronomy	100 00
Donation for lighting University Grounds	1,000 00
Donation for lighting University Library	1,000 00
Richard Gird	23 45
	$987,882 38

Disbursements.

Administration	$14,942 27
Agricultural Experiment Stations	10,322 44
Bills receivable	108,000 00
Cash on hand June 30, 1896	174,619 61
Consolidated Perpetual Endowment Fund	10 00
College of Agriculture	5,712 42
College of Chemistry	4,355 06
College of Civil Engineering	2,266 67
College of Mechanics	5,540 56
College of Mining	965 26
Department of Lick Observatory	5,422 66
Department of Biology	532 33
Department of Military Science	628 54
Department of Mineralogy	692 94
Department of Physics	967 33
Department of Physical Culture	463 38
D. O. Mills Endowment (salaries)	5,499 96
Excess payments due United States	150 00
Fund for installing the Crossley Reflector	2,487 90
Lick Observatory Fund	5,400 00
Library	1,198 34
Museum	240 32
Revenue account	30 96
Geological Survey Reports	17 50
Michael Reese Library Fund (interest)	2,051 54
Students' deposits (diplomas)	2,160 00
State fees	14 00
Toland Medical College	2 00
University site improvement	5,071 04
University Medal Fund	125 00
University Printing Office	599 43
Palmer House	164 19
Morrill College Aid Fund	21,000 00
Department of Botany	508 08
Students' Deposits—Chemical Laboratory	2,612 78
Mining Laboratory	270 42
Physical Laboratory	2,798 55
Library	65 00
North Hall lockers	8 50
Gymnasium lockers	83 50
Biological Laboratory	30 00
Agricultural Laboratory	76 00
Botanical Laboratory	52 00
Military Department	2,959 11
Civil Engineering Laboratory	418 35
Phebe Hearst Scholarships	3,600 00
Frank J. Walton Memorial Loan Fund	125 00
Propagating House, Agricultural Department	2,355 04
Department of Drawing	244 05
Department of Greek	26 46
Department of Latin	32 45
Department of Mathematics	28 94
Department of Decorative and Industrial Art	299 89
Department of Astronomy	279 83
Department of Philosophy	4 97
State appropriation (Forestry)	2,490 53
State appropriation (Viticulture)	1,910 87
State appropriation (Affiliated Colleges building)	608 35
J. Clute Wilmerding Endowment (interest)	334 63
Johnson property	385,000 00
Income from Johnson property	6,402 75
C. F. Crocker donation for eclipse expedition	1,682 53
Agricultural Experiment Stations (sale of produce, etc.)	80 00
Donation to Department of Astronomy	100 00
Donation for lighting University Grounds	988 85
Donation for lighting University Library	965 75
Hearst Fund	100 00
A. Blair Thaw donation	100 00
Salaries	188,585 55
Total	$987,882 38

10. TRIAL BALANCE.

Folio.	Name.	Dr.	Cr.
17	Agricultural Experiment Stations		$981 60
22	Buildings	$483,607 65	
29	Bills receivable	1,143,000 00	
46	Cash, Louis Sloss, Treasurer	174,619 61	
51	Consolidated Perpetual Endowment Fund		1,930,264 00
136	D. O. Mills Endowment		100,000 00
136	D. O. Mills Endowment (interest)		1,667 52
140	Edward Tompkins Endowment		43,385 24
145	Excess payments due United States		890 00
146	German Library		554 88
148	German Savings and Loan Society	563 97	
150	Excess payments on minimum lands		1,363 15
152	Lick Observatory Fund		90,018 16
153	Fund for installing the Crossley Reflector		538 54
181	Revenue account		15,263 82
190	Michael Reese Library Fund		50,000 00
190	Michael Reese Library Fund (interest)		4,871 95
198	Students deposits (diplomas)		12,210 00
212	State Treasurer	856,500 00	
215	State fees	21 00	
216	San Francisco Savings Union	6,104 61	
220	Security Savings Bank	11,814 02	
224	Toland Medical College	5,626 74	
239	University Medal Fund		3,739 72
270	Students' deposits—Chemical Laboratory		643 95
274	Students' deposits—Mining Laboratory		60 00
277	Students' deposits—Physics Laboratory		161 45
280	Students' deposits—Library		220 00
282	Students' deposits—North Hall lockers		95 00
284	Students' deposits—Gymnasium lockers		447 00
290	Phebe Hearst Scholarships		82 00
297	Frank J. Walton Memorial Loan Fund		2,093 45
330	Students' deposits—Botanical Laboratory		5 00
333	Students' deposits—Military Department		49 72
344	Jucksch Donation		50 00
353	State appropriation (Forestry)	962 87	
357	State appropriation (Viticulture)	779 20	
360	State appropriation (Affiliated Colleges buildings)		1,618 72
362	Students deposits—Civil Engineering Laboratory		33 20
364	J. Clute Wilmerding Endowment		400,000 00
364	J. Clute Wilmerding Endowment (interest)		14,099 04
367	Johnson Building	385,000 00	
371	C. F. Crocker donation for eclipse expedition		817 47
372	P. Charles Cole Scholarship		1,000 00
447	Tyler Beach	5,789 60	
449	N. P. Chipman	351 02	
450	J. A. Hardin	573 17	
452	William C. Turner	6,276 32	
453	Agricultural Experiment Stations (sale of produce, etc.)		321 66
460	Contingent funds	1,636 37	
468	Donation by San Francisco University Extension Class		42 77
469	Donation for lighting University Library		34 25
469	Donation for lighting University Grounds		11 15
479	Hearst Fund		1 48
490	Salaries, expenses, and receipts to January 1, 1889		485,340 56
491	State of California	79,750 00	
	Totals	$3,162,976 15	$3,162,976 15

11. DEPARTMENTAL DISBURSEMENTS FOR THE YEAR ENDING JUNE 30, 1896.

Salaries.

Administration	$29,426 35
College of Agriculture	11,358 99
College of Chemistry	15,261 29
College of Civil Engineering	12,993 32
College of Letters	25,687 72
College of Natural Sciences	13,429 06
College of Social Sciences	23,908 81
College of Mechanics	15,636 91
College of Mines	9,594 35
Department of Lick Observatory	20,386 25
Department of Physical Culture	3,229 67
Department of Latin	77 50
Library	4,380 00
Museum	1,050 29
University Printing Office	1,560 00
	$187,980 51

Administration.

Fuel	$1,456 39
Equipment	1,714 64
Repairs	1,373 02
Advertising and printing	134 45
Telegraphing and expressage	594 70
Stationery	259 25
Postage	603 00
Official and lecturing expenses	1,616 70
Water	6,672 37
Insurance	162 25
College celebrations	318 50
Publications	37 00
	$14,942 27

Agricultural Experiment Stations.

Labor	$272 17
Publications	157 68
Postage and stationery	93 63
Freight and expressage	75 79
Heat, light, and water	199 84
Chemical supplies	184 57
Seeds, plants, and sundry supplies	111 16
Fertilizers	148 80
Feeding-stuffs	55 75
Library	74 89
Tools, implements, and machinery	74 58
Furniture and fixtures	53 37
Scientific apparatus	680 77
Live stock	10 00
Traveling	19 10
Contingent expenses	52 50
Buildings and repairs	44 10
	$2,308 70

Labor	$4,081 21
Publications	117 74
Postage and stationery	306 00
Freight and expressage	358 84
Heat, light, and water	127 89
Chemical supplies	153 15
Seeds, plants, and sundry supplies	613 02
Fertilizers	288 64
Feeding-stuffs	253 65
Library	22 49
Tools, implements, and machinery	310 54
Furniture and fixtures	34 00
Scientific apparatus	203 93
Traveling	774 98
Contingent expenses	43 75
Buildings and repairs	323 53
Salaries	6,005 04
	$14,018 40

Forestry Stations.

Chico Station—

Labor	$50 00
Supplies	2 02
Expressage	2 93
Salaries	600 00
Labor	334 05
Supplies	220 55
Traveling	38 85
Expressage	1 70
Postage	15 00
	$1,265 10

Santa Monica Station—

Labor	$15 00
Supplies	50
Salaries	600 00
Labor	260 75
Supplies	298 43
Traveling	21 95
Expressage	9 50
Postage	19 30
	$1,225 43

Viticulture.

Salaries	$649 98
Labor	467 00
Traveling	167 25
Vines	111 36
Books and periodicals	8 15
Postage	25 00
Freight and expressage	44 31
Apparatus and repairs	339 82
Incidentals	98 00
	$1,910 87

Affiliated Colleges.

Buildings	$608 35

Colleges and Departments.

College of Agriculture	$5,712 42
College of Chemistry	4,355 06
College of Civil Engineering	2,266 67
College of Mechanics	5,540 56
College of Mining	965 26
Department of Lick Observatory	5,422 66
Department of Military Science	628 54
Department of Mineralogy	692 94
Department of Physical Culture	463 38
Department of Physics	967 33
Department of Latin	32 45
Department of Greek	26 46
Department of Mathematics	28 94
Department of Botany	508 08
Department of Biology	532 33
Library	1,198 34
Museum	240 32
University Printing Office	599 43
University site improvements	5,071 04
Department of Drawing	244 05
Department of Astronomy	279 83
Department of Decorative and Industral Art	299 89
Department of Philosophy	4 97
Johnson Building	6,402 75
Propagating House	2,355 04
	$44,838 74

C. F. Crocker donation for eclipse expedition	$1,682 53
A. Blair Thaw donation	100 00
Phebe Hearst donation	100 00
Fund for installing the Crossley Reflector, 1894–95	2,508 56
Fund for installing the Crossley Reflector, 1895–96	2,487 90
Donation for lighting University Library	965 75
Donation for lighting University Grounds	988 85

Morrill College Aid Fund (Salaries).

College of Agriculture	$6,999 72
College of Chemistry	1,500 00
College of Civil Engineering	1,500 00
College of Mechanics	4,035 76
College of Mining	2,199 27
Department of Botany (laborers in Botanical Garden, $1,664 60)	3,565 25
Department of Physics	1,200 00
	$21,000 00

12. STATEMENT OF BONDS AND MORTGAGES, JUNE 30, 1896.

Description.	Date of Maturity.	Rate of Interest	Par Value.	Annual Interest.
Bonds.				
State of California	Jan. 2, 1893	6	$610,000 00	$36,600 00
State of California	Jan. 2, 1893	6	141,000 00	8,460 00
City and County of San Francisco:				
Park and Avenue	Jan. 1, 1898	6	50,000 00	3,000 00
Park Improvement	April 1, 1904	6	1,000 00	60 00
Montgomery Avenue	Jan. 1, 1903	------	22,000 00	------------
Fresno County	Jan. 1, 1898	7	12,500 00	875 00
Plumas County	Oct. 3, 1901	6	5,000 00	300 00
Kern County	Nov. 1, 1900	7	15,000 00	1,050 00
Total invested in bonds	------------	------	$856,500 00	$50,345 00
Diverted funds	------------	6	$79,750 00	$4,785 00
Mortgages.				
Oakland real estate			$365,500 00	$23,242 50
San Francisco real estate			517,000 00	31,020 00
Merced County real estate			47,000 00	3,290 00
Sacramento real estate			30,000 00	2,100 00
San José real estate			75,000 00	5,250 00
Marin County real estate			45,000 00	2,700 00
Tehama County real estate			17,500 00	1,225 00
Mendocino County real estate			16,000 00	1,120 00
Alameda County real estate			30,000 00	2,100 00
Total invested in mortgages			$1,143,000 00	$72,047 50
Recapitulation.				
Total invested in bonds			$856,500 00	$50,345 00
Total invested in mortgages			1,143,000 00	72,047 50
Diverted funds			79,750 00	4,785 00
Totals			$2,079,250 00	$127,177 50
Segregation of Bonds and Mortgages.				
Consolidated Perpetual Endowment Fund—Diverted funds			$79,750 00	$4,785 00
Mortgages			569,650 21	37,198 06
Bonds			766,500 00	44,945 00
Lick Observatory Fund—bonds			90,000 00	5,400 00
Michael Reese Library Fund—mortgages			50,000 00	3,000 00
D. O. Mills Endowment—mortgages			100,000 00	6,000 00
University Medal Fund—mortgages			3,529 02	211 32
Edward Tompkins Endowment—mortgages			42,871 72	3,001 32
Frank J. Walton Memorial Loan Fund—mortgages			1,955 05	136 80
J. Clute Wilmerding Endowment—mortgages			375,000 00	22,500 00
Totals			$2,079,250 00	$127,177 50

13. STATE TAX OF ONE CENT ON EVERY $100 VALUATION.

For the Years Ending June 30.

1888—Mar. 31—Controller's warrant	$56,000 00	
May 31—Controller's warrant	20,580 79	
		$76,580 79
1889—July 23—Controller's warrant	$5,962 64	
May 13—Controller's warrant	92,385 74	
		98,348 38
1890—Oct. 5—Controller's warrant	$9,353 04	
April 24—Controller's warrant	91,852 85	
		101,205 89
1891—Dec. 31—Controller's warrant	$463 41	
Mar. 31—Controller's warrant	91,390 11	
Oct. 31—Controller's warrant	10,581 00	
		102,434 52
1892—Oct. 31—Controller's warrant	$9,301 35	
April 30—Controller's warrant	84,057 04	
June 30—Controller's warrant	26,471 73	
		119,830 12
1893—Jan. 31—Controller's warrant	$6,380 22	
April 29—Controller's warrant	80,318 43	
June 30—Controller's warrant	28,876 41	
		115,575 06
1894—Feb. 28—Controller's warrant	$81,042 66	
June 30—Controller's warrant	37,080 73	
		118,123 39
1894—Oct. 31—Controller's warrant	$286 01	
Dec. 31—Controller's warrant	3,471 09	
1895—Feb. 28—Controller's warrant	77,988 73	
June 30—Controller's warrant	38,078 90	
		119,824 73
1895—Aug. 31—Controller's warrant	$2,029 61	
Oct. 31—Controller's warrant	15 00	
1896—Feb. 29—Controller's warrant	75,534 32	
June 30—Controller's warrant	34,964 63	
		112,543 56

14. UNIVERSITY MEDAL FUND.

Dr.			Cr.
To cash from June 30, 1874, to June 30, 1896	$3,010 50	March, 1873, by donation	$2,383 68
To balance	3,739 72	By interest from June, 1873, to June 30, 1896	4,366 54
	$6,750 22		$6,750 22
		1896. June 30—By balance	$3,739 72

15. EDWARD TOMPKINS ENDOWMENT.

Dr.			Cr.
		On Account of Principal.	
Amount of purchase price of Tompkins tract	$50,000 00	By cash to September 1, 1891	$12,790 00
		By cash to September 1, 1892	6,196 91
		By cash to September 1, 1893	1,256 13
		By cash to September 1, 1894	5,601 94
		By cash to September 1, 1895	833 87
		By cash to June 30, 1896	465 00
		By balance	22,856 15
Total	$50,000 00	Total	$50,000 00
		On Account of Interest.	
Interest to September 1, 1895	$6,853 83	By cash to September 1, 1896	$6,323 04
Interest to June 30, 1896	1,135 64	By balance	1,666 43
Total	$7,989 47	Total	$7,989 47

Amount received from W. A. Knowles	$33,466 89
Amount of accrued interest on mortgages	9,918 35
	$43,385 24
Invested as follows:	
In Alameda County mortgages	$42,871 72
Cash with Louis Sloss, Treasurer	513 52
Balance due from W. A. Knowles	24,522 58
Total	$67,907 82

Dr. 16. FRANK J. WALTON MEMORIAL LOAN FUND. Cr.

1893—Dec. 18—To cash	$125 00	1892—April 30—By cash	$1,955 05
1894—Sept. 12—To cash	125 00	By interest to June 30, 1896	513 40
1895—Sept. 10—To cash	125 00		
1896—June 30—To balance	2,093 45		
Total	$2,468 45	Total	$2,468 45

Three notes of $125 each, amounts paid beneficiaries, are on deposit in the Secretary's office, two of them bearing interest at the rate of 6% per annum from May 15, 1895. Interest on the third note does not begin until June 1, 1897.

17. MISS MARY JUCKSCH DONATION.

By cash, rent of land	$10 00
By cash	10 00
By cash, tank-house and windmill	30 00
Total	$50 00

18. STATEMENT FROM DIPLOMA FUND BOOK, SHOWING NUMBER OF DEPOSITS MADE TO JUNE 30, 1896.

	1886–87.	1887–88.	1888–89.	1889–90.	1890–91.	1891–92.	1892–93.	1893–94.	1894–95.	1895–96.
August	-------	-------	-------	-------	-------	-------	199	237	375	386
September	81	102	102	126	142	166	65	65	78	73
October	16	16	26	17	19	44	15	21	10	17
November	2	4	2	5	8	16	3	10	21	11
December	3	2	4	2	3	7	2	3	8	1
January	2	3	2	3	2	4	10	17	36	40
February	2	1	3	11	5	10	11	14	22	22
March	2	1	1	11	3	4	1	6	4	13
April	-------	4	-------	-------	2	1	-------	1	2	3
May	-------	-------	-------	3	3	1	1	-------	2	2
June	-------	-------	-------	2	1	1	1	-------	1	1
Totals	108	133	140	180	188	254	308	374	559	569

	Withdrawn.	Diplomas Issued.	Balance on Deposit.	Total.
1886–87	49	47	12	108
1887–88	69	57	7	133
1888–89	78	54	8	140
1889–90	90	79	11	180
1890–91	88	83	17	188
1891–92	112	108	34	254
1892–93	138	118	52	308
1893–94	140	27	207	374
1894–95	149	14	396	559
1895–96	82	12	475	569
Totals	995	599	1,219	2,813

19. DIPLOMA FUND.

At the meeting of the Board of Regents, held August 11, 1891, the following report was adopted:

Your Committee on the Diploma Fund respectfully recommend that the money of this fund on hand, and as received hereafter, be paid into the Consolidated Perpetual Endowment Fund of the University of California.

Under the foregoing ruling, the following amounts have been transferred to the Consolidated Perpetual Endowment Fund:

June 30, 1892	$660 00
June 30, 1893	720 00
June 30, 1894	1,030 00
June 30, 1895	1,120 00
June 30, 1896	1,460 00
	$4,990 00

20. RECEIPTS AND EXPENDITURES OF THE REESE LIBRARY FUND TO JUNE 30, 1896.

Expenditures.		Receipts.	
To June 30, 1881	$781 93	By June 30, 1880	$3,444 44
To June 30, 1882	5,459 78	By June 30, 1881	5,000 00
To June 30, 1883	3,235 11	By June 30, 1882	3,574 99
To June 30, 1884	5,278 19	By June 30, 1883	3,000 00
To June 30, 1885	3,340 06	By June 30, 1884	3,000 00
To June 30, 1886	1,945 71	By June 30, 1885	1,630 90
To June 30, 1887	1,405 84	By June 30, 1886	2,825 94
To June 30, 1888	3,275 94	By June 30, 1887	2,942 73
To June 30, 1889	3,321 11	By June 30, 1888	3,062 52
To June 30, 1890	2,490 33	By June 30, 1889	3,182 31
To June 30, 1891	3,846 44	By June 30, 1890	3,219 93
To June 30, 1892	2,809 58	By June 30, 1891	2,608 74
To June 30, 1893	1,925 73	By June 30, 1892	3,335 25
To June 30, 1894	5,124 00	By June 30, 1893	3,182 39
To June 30, 1895	2,351 59	By June 30, 1894	2,109 45
To June 30, 1896	2,051 54	By June 30, 1895	1,724 15
To balance	4,871 95	By June 30, 1896	5,671 09
	$53,514 83		$53,514 83
To outstanding bills for books, estimated	$820 00		
Estimated balance	4,051 95	By balance	$4,871 95
	$4,871 95		$4,871 95

21. EXPENDITURES FOR THE LIBRARY FROM THE GENERAL FUND FOR THE YEAR ENDING JUNE 30, 1896.

Current expenses	$139 40
Purchase of books	93 16
Purchase of periodicals	965 78
	$1,198 34

22. The President's House.

In purchasing the Palmer tract, $10,000 was considered the value of one portion of that tract, namely, the President's house and lot. On this basis, and considering the expenditure as an investment, I give the percentage of income on the principal invested:

Total amount received for rent from June 30, 1888, to June 30, 1896	$5,820 00
Total cost of repairs for same period	1,477 50
Net receipts	$4,342 50

Showing the interest on the investment to be at the rate of 5.42+ per cent per annum.

The remainder of the Palmer tract is non-productive.

23. University Cottages.

Total cost of building cottages (October, 1874)	$27,226 06
Total amount of rent received from November, 1874, to June 30, 1896	$31,921 27
Total cost of repairs for same period	7,465 52
Net receipts	$24,455 75

Showing the interest on the investment to be at the rate of 4.08+ per cent per annum.

One of the cottages was burned during June, 1895.

24. Sale of Geological Survey Reports.

The following is a statement of money realized by sale of Geological Survey Reports, paid to the State Treasurer and credited to the School Fund:

1875—27th fiscal year	$335 70
1876—28th fiscal year	133 60
1877—29th fiscal year	90 40
1878—30th fiscal year	310 25
1879—31st fiscal year	245 91
1880—32d fiscal year	57 40
1882—33d fiscal year	------
1883—34th fiscal year	95 90
1884—35th fiscal year	152 95
1885—36th fiscal year	------
1886—37th fiscal year	59 50
1887—38th fiscal year	15 05
1888—39th fiscal year	------
1889—40th fiscal year	24 50
1890—41st fiscal year (voucher 6633)	6 65
1891—42d fiscal year	------
1892—43d fiscal year	------
1893—44th fiscal year (voucher 12326)	21 70
1894—44th fiscal year	------
1895—45th fiscal year (voucher 15575)	14 00
1896—46th fiscal year (voucher 18450)	17 50
Total	$1,581 01

As will be seen by the above report, the receipts for sale of Geological Survey Reports, etc., have been rapidly decreasing. Of the reports ready for sale there remain very few, and their value cannot be estimated as greater than $250.

25. LABORATORY FEES.

The under-mentioned amounts were turned into the University treasury from charges for chemicals and apparatus in the various laboratories during the year ending June 30, 1896:

Chemical laboratory	$4,398 17
Physical laboratory	2,644 80
Mining laboratory	315 09
Biological laboratory	435 00
Agricultural laboratory	44 00
Civil Engineering laboratory	347 75
Botanical laboratory	58 00
Total	$8,242 81

26. INSURANCE.

The following is a list of insurance now in force:

	Premium.	Amount.	Date of Expiration.
Military arms and accouterments	$16 85	$936 32	January 27, 1899
Military arms and accouterments	17 50	971 84	April 21, 1897
Military arms and accouterments	84 20	7,014 78	May 23, 1898
Military arms and accouterments	20 40	1,698 75	September 3, 1898
Military arms and accouterments	44 15	2,452 15	November 24, 1897
Military arms and accouterments	21 65	1,806 00	May 11, 1899
Johnson property		7,500 00	November 12, 1898
Johnson property		7,500 00	
Johnson property		2,500 00	
Johnson property		10,000 00	
Johnson property		15,000 00	
Johnson property		15,000 00	
Johnson property		10,000 00	
Johnson property		7,500 00	
Johnson property		5,000 00	
Johnson property		5,000 00	
Johnson property		7,500 00	
Johnson property		7,500 00	
Johnson property on boilers	37 50	5,000 00	November 13, 1896
Johnson property on plate glass	44 75		August 6, 1897
Johnson property on elevators (accident)	50 00	10,000 00	May 24, 1897

That portion of above insurance inclosed in brace was placed prior to the purchase of the building and was turned over to the University.

27. MILITARY DEPARTMENT.

Students' Deposits for Military Uniforms.

Dr.		Cr.	
1894.		1894.	
Nov. 14—To cash	$646 69	Aug. 31—By cash	$1,086 85
Dec. 12—To cash	2,665 49	Sept. 29—By cash	1,743 87
1895.		Oct. 31—By cash	539 02
Feb. 13—To cash	217 64	Nov. 30—By cash	198 40
Apr. 10—To cash	172 70	1895.	
June 13—To cash	16 72	Jan. 31—By cash	108 40
June 30—To revenue account	43 48	Feb. 28—By cash	85 75
Sept. 30—To cash	31 25	Apr. 30—By cash	17 15
Oct. 9—To cash	1,335 70	Aug. 31—By cash	1,326 05
Nov. 13—To cash	1,427 17	Sept. 30—By cash	1,181 70
Dec. 11—To cash	42 75	Oct. 31—By cash	176 50
1896.		Nov. 30—By cash	211 29
Jan. 15—To cash	57 28	1896.	
Mar. 11—To cash	64 96	Jan. 31—By cash	66 00
June 30—To revenue account	2 43	Feb. 9—By cash	16 50
June 30—To balance	49 72	Mar. 31—By cash	16 50
Total	$6,773 98	Total	$6,773 98

To balance due students	$16 72
To balance due contractor	33 00
	$49 72

Ordnance and Ordnance Stores in Possession of the University of California, June 30, 1896.

525 Springfield Cadet rifles.
50 cavalry sabers.
10 N. C. O. and musicians' swords.
525 infantry equipment.
428 headless shell-extractors.
100 blank cartridges.
1,200 metallic blank cartridges.
5,800 metallic ball cartridges.
300 friction primers.
50 saber belts.
10 sliding frogs for N. C. O. and musicians' waist belts.
1 3:2-inch B. L. rifle, with implements.
1 3:2-inch steel gun, with implements.
2 carriages and limbers for 3:2-inch B. L. rifle.
170 paper targets.

Bonds for Arms and Ammunition.

The following is a list of the bonds to the United States heretofore executed by the Regents for arms and ammunition:

Under date of August 14, 1883 (Minutes, Vol. 5, p. 128)	$3,099 00
Under date of January 8, 1889 (Minutes, Vol. 7, p. 216)	4,000 00
Under date of March 10, 1891 (Minutes, Vol. 8, p. 320)	115 00
Under date of October 13, 1891 (Minutes, Vol. 9, p. 21)	5,000 00
Under date of October 11, 1892 (Minutes, Vol. 9, p. 183)	1,872 64
Under date of November 14, 1893 (Minutes, Vol. 9, p. 376)	6,716 30
Under date of April 9, 1895 (Minutes, Vol. 10, p. 85)	3,397 50
Under date of November 12, 1895 (Minutes, Vol. 10, p. 178)	1,793 00
	$25,993 44

Officers of University Cadets.

The following were commissioned by Governor Budd, May, 1896:

Alexander McCulloch	Colonel.
Willard Dawson Thompson	Lieutenant-Colonel.
Harrington Bidwell Graham	Major.
Herbert William Allen	Captain.
Philip Lee Bush	Captain.
Edwin Tyler Blake	Captain.
George Dudley Kierulff	Captain.
Howard Potter Veeder	Captain.
Raymond John Russ	Captain.
Tracy Randall Kelley	First Lieutenant.
Anthony White Dozier	First Lieutenant.
Edward James Crawford	First Lieutenant.
Charles Woodman Morse	First Lieutenant.
Gilbert Stoddard Walker	First Lieutenant.
Edwin Rushmore Jackson	First Lieutenant.
Clyde Algernon Allen Cross	First Lieutenant.

All of which is respectfully submitted.

J. H. C. BONTÉ,
Secretary Board of Regents.

APPENDICES.

THE UNIVERSITY LIBRARY IN 1895-96.

Report of J. C. Rowell, Librarian.

During the last year the library has been a veritable hive of industry. The average all-day attendance of readers, as shown by a census taken seven times a day in the month of March, was 135.1—a slight increase over that of the previous year. Our accommodations for readers have been taxed nearly to the limit of floor space for chairs and tables.

From March 11th to May 12th, for five days each week, the library was open continuously from 8:20 A. M. until 10 P. M. The average evening attendance, according to census taken at the hours of seven, eight, and nine, was 19.6 for March, 22 for April, and 11.6 for May.

GROWTH.

On June 30, 1896, there were 63,475 volumes recorded on the accessions register. The additions for the year 1895-96 are as follows:

(*a*) By purchase (Reese Fund)	978 volumes.
By purchase (General Fund)	55 volumes.
By purchase (German Library Fund)	2 volumes.
By purchase for departmental libraries	95 volumes.
	1,130 volumes.
(*b*) By exchange	2 volumes.
(*c*) By binding of periodicals (General Fund)	0 volumes.
(*d*) By gift	*1,870 volumes.
Total received	3,023 volumes.
Pamphlets received by gift	3,503 numbers.

Purchases for the year include Goodyear's Grammar of the Lotus; Plautus ed. by Ussing; Sullivant's Icones muscorum; Dinaux, Trouvères du nord de France; Larned's History for Ready Reference; Aristotle in Barthélemy St. Hilaire's French translation; St. Jerome's Opera; and complete (or completing) sets of the following periodicals:

American Society of Mechanical Engineers. 15 vols.
Cosmopolitan. 11 vols.
Just's Botanischer Jahresbericht. 19 vols.
Landwirthschaftliche Jahrbücher. 21 vols.
Naples Zoölogical Station.
Bulletin of the St. Petersburg Academy. 32 vols.
Zeitschrift für Deutsches Alterthum. 17 vols.

GIFTS.

A very valuable collection of Reports of State Supreme Courts and other courts of last resort in the United States, 402 volumes, was presented by the Bancroft-Whitney Company, of San Francisco, and the following alumni of the University: George D. Boyd, William G. Brittan, William R. Daingerfield, E. S. Heller, Jerome B. Lincoln, Alex. F. Morrison, Arthur Rodgers, Charles W. Slack, and Charles S. Wheeler.

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* Includes 561 volumes received from the California State Viticultural Commission.

From the Government of Great Britain was received a set of the valuable Scientific Results of the Voyage of the Challenger, in 50 volumes.

From J. B. Randol came a collection of books and pamphlets on quicksilver mining and metallurgy; from Hon. William Alvord, a set of San Francisco Municipal Reports; from Marsden Manson, 26 volumes of engineering and meteorological books; and from Regent A. S. Hallidie a set of the Iron Age, in 44 volumes.

COLLECTION OF CALIFORNIA AUTHORS.

Mr. Samuel Putnam Avery, of New York, has presented 29 volumes including a set of the works of Noah Brooks; and about 50 volumes have been added by purchase. Other contributors to this collection are Dr. Jerome A. Anderson, Harold Bolce, Clara Spalding Brown, Fred L. Button, Prof. George C. Edwards, George Hansen, E. I. Hoffman, Dr. Edward S. Holden, Mrs. Mary H. Jarboe, Prof. Josiah Keep, Herbert Lang, Prof. J. G. Lemmon, Arthur McEwen, Alex. F. Morrison, Prof. Bernard Moses, Edward A. Rix, R. H. Savage, Charles H. Shinn, George H. Smith of Los Angeles, Claus Spreckels, and Professor John M. Stillman.

MISCELLANEOUS GIFTS.

Mr. Oliver Ellsworth, of Niles, presented a copy of the exceedingly rare certificate of scholarship, dated November 28, 1854, issued by the College of California to the late Ira P. Rankin. It has been framed.

Mr. Samuel Putnam Avery sent a fine portrait in oil (by Baker, 1866; copy by Ryder) of Hon. Benjamin Parke Avery, the genial and talented California journalist.

A portrait of Rev. Dr. Horatio Stebbins (by Vermorcken) has been presented by friends of the Regent and of the University.

From Mr. Rounsevelle Wildman, of the Overland Monthly, were received two extremely rare silver-plated lead petties used as money by the Malays prior to 800 A. D.; and the first specimen received in California of the 1895 coinage Anglo-Chinese silver dollar was added to our numismatic collection by Hon. William Alvord.

LOSSES.

A careful systematic inventory of the library, taken in June, showed that during the year 1895–96 thirty-seven volumes had disappeared and were still unaccounted for. Fifty-two out of the 137 volumes lost during 1894–95, and 6 volumes lost during 1893–94, have silently found their way back to the shelves.

NEW EXCHANGES.

New exchanges for the Bulletin issued by our Department of Geology:

34. Budapest. Kgl. Ungarische Geologische Anstalt.
35. Cape Town. Geological Commission.
36. Chicago. Field Columbian Museum.
37. Mexico. Instituto Geologico.
38. Strassburg. Geol. Landes-Untersuchung v. Elsass-Lothringen.

New general exchange institutions number six:

Chicago. Chicago Academy of Sciences.
Athens. National University.
Liverpool. Literary and Philosophical Society.
Nantes. Société Académique.
Santiago, Chile. Société Scientifique.
Turin. R. Accademia delle Scienze.

NEEDS OF THE LIBRARY.

A larger endowment for the purchase of books is imperatively needed. The income of the Reese Fund is sufficient, perhaps, to furnish all books needed for a *village* public library, but is totally inadequate to supply this University with books. The University does not purchase more than *one in ten* of books *currently* issued from the press which ought to be in the library for use, and only a very small percentage of the publications of the less recent past are secured. The income divided among twenty-five departments serves simply to save them from starvation and stagnation; and the progress of professor and student is vexatiously limited, especially in all branches of philology, literature, philosophy, history, and economics.

The Reese Fund of $50,000 has yielded about $50,000 in interest since its receipt in 1879, all of which interest has been expended under expert advice for *books* supposed to be of permanent value. The judicious financial management by the Board of Regents, of this bequest by Michael Reese, and their scrupulous observance of its terms, deserve to be called to the attention of all friends of the University.

Smaller sums of $5,000, $10,000, or $20,000, could be devoted by donors to the endowment of single departments in the library, like English Literature, or Political Economy, or Mathematics. The libraries of the principal universities in the East have received by gift in recent years very large endowments, apparently in recognition of the new and important relation the library has taken to university work, due to modern methods of instruction. Will not *Californians*, never niggardly, awake to the perception of *our* needs ?

BACON ART GALLERY.

No additions have been made this year. During 1895–96 there were 3,792 visitors to the gallery; total number since the opening in 1882 is 53,507.

REPORT ON PUBLICATIONS.

1. Greek pamphlet (Professor Flagg's Attic Prose). No report.
2. Bulletins of the Department of Geology:

		Copies.	
No. 1.	To subscribers	5	
	Exchange and gift	19	
	On hand July 1, 1896	266	
			290
No. 2.	To subscribers	5	
	To sales	1	
	Exchange and gift	19	
	On hand	263	
			288

No. 3.	To subscribers	5	
	To sales	1	
	Exchange and gift	19	
	On hand	264	
			289
No. 4.	To subscribers	5	
	Exchange and gift	19	
	On hand	262	
			286
Nos. 5–6.	To subscribers	5	
	To sales	2	
	Exchange and gift	19	
	On hand	275	
			301
No. 7.	To subscribers	5	
	To sales	2	
	Exchange and gift	19	
	On hand	276	
			302
No. 8.	To subscribers	5	
	To sales	1	
	Exchange and gift	19	
	On hand	307	
			332
No. 9.	To subscribers	5	
	To sales	4	
	Exchange and gift	19	
	On hand	301	
			329
No. 10.	Received from printer		641
	To library	2	
	To subscribers	107	
	To sales	32	
	Exchange and gift	199	
	Periodicals for review	15	
	On hand	286	
			641
No. 11.	Received		669
	To library	3	
	To subscribers	107	
	To sales	7	
	Exchange and gift	198	
	Periodicals for review	23	
	On hand	331	
			669
No. 12.	Received		641
	To library	2	
	To subscribers	107	
	To sales	1	
	Exchange and gift	87	
	Periodicals for review	15	
	On hand	429	
			641
No. 13.	Received		660
	To library	2	
	To subscribers	107	
	Exchange and gift	86	
	Periodicals for review	15	
	On hand	450	
			660
No. 14.	Received		639
	To library	2	
	To subscribers	107	
	To sales	1	
	Exchange and gift	85	
	Periodicals for review	9	
	On hand	435	
			639
Vol. 2, No. 1.	Received		498

3. University studies:

No. 1.	On hand and received (122+300)		422
	Sales	191	
	Exchange and periodicals	12	
	On hand July 1, 1896	219	
			422
No. 2.	On hand		389
	Sales	192	
	Exchange and periodicals	10	
	On hand July 1, 1896	187	
			389

Sales July 1, 1895, to June 30, 1896:

Geology Bulletin,	No. 2.	1 copy, at 10 cents	$0 10
	No. 3.	1 copy, at 40 cents	40
	Nos. 5–6.	2 copies, at 30 cents	60
	No. 7.	2 copies, at 45 cents	90
	No. 8.	1 copy, at 30 cents	30
	No. 9.	4 copies, at 25 cents	1 00
	No. 10.	32 copies, at 10 cents	3 20
	No. 11.	7 copies, at 20 cents	1 40
	No. 12.	1 copy, at 20 cents	20
	No. 14.	1 copy, at 45 cents	45
	Vol. 1.	8 paid subscriptions, at $3 50	28 00
University studies,	No. 1.	191 copies, at 25 cents	47 75
	No. 2.	192 copies, at 25 cents	48 00
Total			$132 30
Sales previously reported—1893–95			96 15
Total sales			$228 45

LIST OF DONATIONS TO THE LIBRARY—1895–96.

Presented by—	Books.	Pamphlets.
Aberdeen University	1	
Adams, C. K., Madison, Wis.		1
Adams, Mrs. M. M., Madison, Wis.	1	
Add-Ran Christian University		1
Adelaide Observatory	3	
Alabama Agricultural Experiment Station		6
Alabama Geological Survey		1
Alabama Industrial and Scientific Society		1
Alabama Polytechnic Institute		1
Albee, Ernest		1
Alcorn Agricultural and Mechanical College		2
Allyn & Bacon	1	
Alvord, Hon. Wm. (besides 30 duplicates)	6	9
American Academy of Science	2	
American and Continental Sanitas Co.		1
American Antiquarian Society		4
American Book Co.	1	
American Catholic Historical Society		4
American Geographical Society		1
American Historical Association	1	
American Humane Association		2
American Institute of Mining Engineers	1	
American Library Association		2
American Microscopical Society		1
American Museum of Natural History		2
American Philosophical Society		3
American Society of Mechanical Engineers	1	
American Type Founders' Co., San Francisco	1	
Amherst College		1
Amsterdam Universität	1	
Anderson, J. A., San Francisco	1	
Andover Theological Seminary		1
Anonymous	3	
Anthony, H. M., U. C. 1895	1	

LIST OF DONATIONS TO THE LIBRARY—Continued.

Presented by—	Books.	Pamphlets.
Ardley, Prof. H. T., U. C.	--------	2
Arizona University	--------	1
Arkansas College	--------	1
Astronomical Society of the Pacific	--------	5
Athens University	--------	5
Atlanta University	--------	1
Avery, S. P., New York	29	--------
Balch, T. W., Philadelphia	1	--------
Baldwin University	--------	1
Baltimore College of Dental Surgery	--------	2
Bancroft-Whitney Co., and others (besides 16 duplicates)	402	--------
Bar-le-Duc Société des Lettres	--------	1
Barrows, H. D., Los Angeles	--------	3
Basel Naturforschende Gesellschaft	--------	2
Basel Universität	--------	67
Batavia Magnet en Meteorol. Observatorium	1	--------
Bath and West of England Society	1	--------
Belmont School	--------	2
Beloit College	1	1
Berea College	--------	1
Berlin Akademie der Wissenschaften	1	1
Berlin Physikalische Gesellschaft	--------	1
Berlin Universität	1	83
Bern Geographische Gesellschaft	--------	3
Beziers Société d'Étude des Sciences Naturelles	--------	1
Blackburn University	--------	1
Bodleian Library, Oxford	1	7
Bolce, Harold, Johannesburg	1	--------
Bonalde, J. A. P., Valparaiso	--------	1
Bonn Universität	--------	19
Bonté, Dr. J. H. C.	1	3
Boston College	--------	2
Boston Museum of Fine Arts	--------	1
Boston Public Library	1	4
Boston Record Commissioners	1	--------
Boston Society of Natural History	--------	1
Boston University	--------	2
Bowdoin College	--------	3
Breslau, Schlesische Gesell. für vaterländische Cultur	--------	2
Breslau Universität	--------	33
Brewer, W. A., U. C. 1885	--------	1
British Association for the Advancement of Science	1	--------
British Columbia Department of Mines	--------	1
British Museum	3	--------
Brookline Library	--------	5
Brooklyn Ethical Association	--------	1
Brooklyn Library	--------	2
Brooklyn Polytechnic Institute	--------	1
Brooks, Miss L. E., Berkeley	--------	2
Brown, Clara Spalding	1	--------
Brown, Prof. E. E., U. C.	--------	1
Brown, L. H.	--------	1
Brown, Pres. S. G., Hamilton College	1	--------
Brown University	--------	4
Bryn Mawr College	--------	3
Bucarest Institute Meteorologique	--------	1
Budapest, K. Ungar. Geologische Anstalt	--------	7
Buffalo Historical Society	--------	1
Buffalo Public Library	--------	2
Bush, Rob. E., U. C. 1887	--------	1
Butters, Charles, Johannesburg	1	4
Button, Fred L., U. C. 1876	1	--------
California Academy of Sciences	1	2
California Board of Health	2	7
California Bureau of Labor	1	--------
California Climate and Crop Service	--------	7
California College	--------	1
California Home for Feeble-Minded Children	--------	3

List of Donations to the Library—Continued.

Presented by—	Books.	Pamphlets.
California Mining Bureau	1	
California School of Mechanical Arts		1
California Society of Pioneers		3
California State Normal School, Chico		1
California State Normal School, Los Angeles		1
California State Printer	17	3
California State Superintendent of Public Instruction	4	
California State Viticultural Commission (besides 377 duplicates)	561	
Canadian Geological Survey		5
Canadian Institute		3
Cape Colony Department of Agriculture		1
Carleton College		2
Catholic University of Washington		5
Centenary College		2
Central College		1
Chamisso Botanical Club		1
Chandler, A. E., U. C. 1896	3	
Chapin, G. L., Chicago	1	
Chicago Academy of Sciences		14
Chicago Field Columbian Museum		7
Chicago Law Institute	1	
Chicago Public Library		1
Chicago Theological Seminary		1
Chicago University		1
Chipman, M. M., M.D.		1
Christiania Norske Geografiske Selskabs		1
Christiania Videnskabs-Selskabet		21
Cincinnati Public Library		5
Cincinnati Society of Natural History		2
Cincinnati University		2
Clapp, Prof. E. B., U. C.		4
Clark University		1
Cleveland Public Library		2
Cobden Club		2
Coimbra Universidad		1
Colby University		1
Cole, Geo. Watson		1
Colgate University		2
College of St. Joseph		1
Colmar Naturhistorische Gesellschaft		1
Colorado State Agricultural College		4
Colorado State School of Mines		1
Colorado University		1
Columbia University		7
Comes, Dr. O., Naples		1
Connecticut Agricultural Experiment Station		9
Cope, Prof. E. D.		5
Cornell College		1
Cornell University		8
Crocker, Uriel H., Boston	1	
Cromwell, A. D., Fort Dodge, Iowa	1	
Crossley, Edward (through Dr. E. S. Holden)	4	
Cummings, Miss S. M. N.		14
Cust, Dr. N., London	1	
Dalhousie University		1
Dall, W. H., Washington		1
Dante Society, Cambridge, Mass.		1
Dartmouth College		1
Davies, T. A., New York	1	
Davis, A. McF.		2
Davy, J. Burtt, U. C.	2	3
De Laguna, A. de Leo., U. C.	1	
Delaware College Agricultural Experiment Station		7
Denver Public Library		1
Desi, Enri D., U. C.	1	1
Des Moines College		1
Detroit Museum of Art		1
Detroit Public Library		1
Dill, Mrs. Helen, U. C.	3	

LIST OF DONATIONS TO THE LIBRARY—Continued.

Presented by—	Books.	Pamphlets.
Dokautschaeff, Prof. V.		1
Dresden Naturwissenschaftliche Gesellschaft		2
Drew Theological Seminary		1
Eden College, St. Louis		1
Edinburgh University	1	
Edwards, Prof. G. C., U. C.	1	
Elisha Mitchell Scientific Society		1
Ellis Publishing Co.		1
Elsass-Lothringen Geologischen Landesanstalt	3	
Emanu-El Sisterhood		1
Emporia College		1
Engelhardt, B. d', Dresden	1	
Engineer and Contractor		1
Engineer's Society of Western Pennsylvania		8
Enoch Pratt Free Library		1
Erlangen Universität		302
Essex Institute		2
Faber, Rev. Ernest, Shanghai		1
Firenze Biblioteca Nazionale Centrale		12
Fiske University		1
Flagg, Prof. Isaac, U. C.	1	
Fleetwood, Maj. C. A.		1
Florida Experiment Station		6
Florida Superintendent of Schools	1	
France Ministére de l'Agriculture		9
Frankfurt Naturforschende Gesellschaft		6
Franklin College		1
Franklin and Marshall College		1
Fraser & Chalmers, Chicago	1	
Freiburg Universität		3
Fremery, James de, San Francisco		1
Friends' Society, Philadelphia		1
Fritsche, Dr. H.		1
Furman University		1
Geddes, J., Jr.		1
General Theological Seminary, New York		1
Geneva Université	5	1
Georgetown University		1
Georgia Department of Agriculture	1	2
Gibbons, Dr. W. P., Alameda (besides 2 duplicates)	21	
Giessen Universität		22
Gilbert, D. W., U. C.		1
Gilbert, Mrs. D. W.		2
Glacialist Magazine		2
Glasgow University	1	
Gloversville Free Public Library		1
Goodenow, S. B., Battle Creek, Iowa	1	
Gothenbourg Kgl. Vetenskaps-och Vitterhets-Samhalle		2
Göttingen Kgl. Gesellschaft der Wissenschaften		8
Göttingen Universität	5	67
Granada Universidad		1
Graz Universität	1	6
Great Britain Council on Education		1
Great Britain Inspector of Explosives		5
Great Britain Lords-Commissioners of the Treasury	50	
Green, S. S., Worcester	1	4
Greifswald Universität		110
Groningen Universiteit		1
Gunnison, A. W., U. C.		1
Gustavus Adolphus College		1
Hahnemann Hospital College		1
Halle Universität	1	48
Hallidie, A. S., San Francisco	44	
Hamilton Association		1
Hamilton College		1
Hamlin University		1

List of Donations to the Library—Continued.

Presented by—	Books.	Pamphlets.
Hampden-Sidney College	--------	1
Handley, F., U. C. 1899 (and others)	1	--------
Hansen, George, Amador	1	--------
Harris, Thos. Lake (besides 2 duplicates)	13	--------
Harris, Dr. W. T., Washington	2	--------
Hartford Public Reading-Rooms	--------	1
Hartford Theological Seminary	--------	2
Harvard Law School Association	1	--------
Harvard University	3	10
Hastings College	--------	1
Haverford College	--------	1
Hawaii Department of Foreign Affairs	--------	2
Hawksworth, A. S., Albany	1	--------
Heath, D. C., Boston	--------	1
Hebrew Technical Institute	--------	1
Heidelberg Universität	--------	1
Heidelberg University, Ohio	--------	1
Helena Public Library	--------	2
Highland and Agricultural Society of Scotland	1	--------
Hilborn, Hon. S. G.	--------	4
Hilgard, Prof. E. W., U. C.	1	--------
Hoffman, E. I., Stockton	1	--------
Holden, Dr. E. S., Lick Observatory (and 12 photos)	7	59
Horne, C. H., Chicago	1	--------
Hotchkiss School	--------	1
Howard, Prof. A. A., Cambridge	--------	1
Howard Association	--------	2
Howard University	--------	2
Howe, M. A., U. C.	1	1
Howison, Prof. G. H., U. C.	3	1
Hurd, John C., New York	1	--------
Idaho Agricultural Experiment Station	--------	2
Illinois Bureau of Labor Statistics	1	--------
Illinois State Laboratory of Natural History	1	--------
Illinois Wesleyan University	--------	1
India Geological Survey	--------	3
Indian Rights Association	--------	5
Indiana Board of Health	1	--------
Indiana State Geologist	1	--------
Indiana University	--------	1
Institution of Civil Engineers	9	--------
International Deep Waterways Association	1	--------
Iowa Academy of Sciences	1	--------
Iowa Geological Survey	2	--------
Iowa State Agricultural College	--------	1
Iowa State Historical Society	--------	7
Iowa State University	--------	1
Irish, Hon. John P.	--------	1
Italy Ministero di Agricoltura	1	6
Jack, L. P., Brisbane, Queensland	--------	3
Jacobs, H. von, Berlin	1	1
James, Prof. E. J.	--------	6
Japan Geological Survey	1	--------
Japan Imperial University	--------	4
Jarboe, Mrs. Mary H., San Francisco	1	--------
Jefferson Davis College	--------	1
Jersey City Free Public Library	--------	8
Jewett, Miss Fidelia, San Francisco	2	--------
Johns Hopkins University	6	37
Jones, C. K., U. C.	--------	2
Jurjew Universität	--------	17
Kahler, P., and Sons, New York	1	--------
Kansas State Historical Society	--------	1
Kansas University	--------	2
Kansas Wesleyan University	--------	1
Keeler, James	--------	2
Keep, Josiah, Mills College	1	--------

LIST OF DONATIONS TO THE LIBRARY—Continued.

Presented by—	Books.	Pamphlets.
Kellogg, President M., U. C. (besides 13 duplicates)	41	2
Kentucky State College		7
Kenyon College		1
Kiel Universität		11
Knight, C. L., U. C. 1893	2	
Knoflach, Augustin	1	
Knox College		1
Königsberg Universität		55
Königsberg Physikalisch-ökonomische Gesellschaft		5
Krakow Meteorological Observatory		1
Kuntze, Otto, Berlin		1
Lafayette College		1
Lagrange College		1
Lake Forest University		1
Lang, Herbert, U. C. 1875	1	
Lang, Mrs. Herbert	3	
Lawrence Free Public Library		1
Layman, J. D., U. C.		1
Le Conte, Dr. Jos., U. C.		6
Leffingwell, Dr. H., Cambridge, Mass.		6
Leiden Universiteit	1	5
Leipzig Universität		7
Leland Stanford Junior University	2	4
Leland University		1
Lemmon, J. G., Oakland	1	
Lenher, Victor, U. C.		5
Lenox College		1
Lewis, Prof. E. P., U. C.		1
Lezinsky, D. L., U. C. 1884	1	
Liège Société Géologique de Belgique		5
Liège Université		3
Lille Université		5
Lincoln University		1
Lisbon Commissao dos Trabalhos Geologicos		1
Liverpool Engineering Society	2	1
Liverpool Geological Association	1	
Liverpool Literary and Philos. Society	6	
London Institution of Mechanical Engineers		3
Los Angeles Board of Health		8
Los Angeles Public Library	1	
Louisiana State Experiment Station		4
Louvain Université	1	20
Lubin, David, Sacramento		2
Luther College		1
Lyon Université		2
Macalister College		1
McCall, John A.	1	
McEwen, Arthur, San Francisco	1	
McGill University		3
Macmillan & Co.	1	
Macullar, Parker & Co., Boston	1	
Madrid Universidad		2
Maine State College		1
Manitoba Medical College		1
Manson, Marsden, Sacramento (besides 7 duplicates)	26	11
Marburg Universität		83
Marietta College		1
Martin Luther College		1
Maryland Agricultural College		10
Massachusetts Agricultural Experiment Station		11
Massachusetts Board of Education	1	
Massachusetts Board of Health	1	
Massachusetts Board of Lunacy and Charity	1	
Massachusetts Bureau of Statistics of Labor	2	
Massachusetts Commission of Public Works		5
Massachusetts Commission of Public Records	1	
Massachusetts Institute of Technology		2
Massachusetts Railroad Commissioners	1	

LIST OF DONATIONS TO THE LIBRARY—Continued.

Presented by—	Books.	Pamphlets.
Maynard, Merrill & Co., New York	1	
Meadville Theological School		1
Melbourne Department of Mines		1
Melbourne Observatory		6
Melbourne Royal Society		1
Melbourne University	1	
Meriden Scientific Association		1
Merrill, Prof. W. A., U. C.	4	4
Mexico Comision Geologica	1	3
Mexico Sociedad Cientifica		4
Miami University		1
Michigan Agricultural Experiment Station		8
Michigan Engineering Society		2
Michigan Mining School		1
Michigan State Agricultural College		1
Michigan State Board of Health	2	
Michigan University		6
Midland College		2
Milan Regio Instituto Tecnico Superiore		1
Mills College		1
Minneapolis Public Library		1
Minnesota University	1	12
Miss Horton's School		1
Mississippi State University		2
Missouri A. and M. College		6
Missouri Botanical Club		1
Missouri Geological Survey	5	
Missouri State University		1
Missouri Valley College		2
Monroe, Will S.		1
Mons. Société des Sciences du Hainaut	16	
Montague, H. B., U. C. 1891	1	
Montana College		4
Montgomery, Dr. D. W., U. C.		3
Morris, Robert, La Grange, Ky.	1	
Morrison, Alex. F., U. C. 1878	1	
Moses, Prof. B., U. C.	1	1
Mount Holyoke College		1
Mount Tamalpais Military Academy		1
Muhlenberg College		1
Munich Akademie der Wissenschaften		3
Munich Akademischer Verlag		1
Murdock, Charles A.		1
Nancy Academie de Stanislaus		1
Nancy Université		1
Nantes Société Académique		2
Naples Accademia della Scienze Fisiche, etc.		8
Naples Accademia Pontaniana		1
National Academy of Sciences	2	1
National Association of Wool Manufacturers		3
National Civil Service Reform League		1
Natural History Society of New Brunswick		1
Nebraska University		1
Nevada State Weather Service		6
Nevada State University		2
Newark Free Public Library		4
Newark Technical School		1
New Bedford Free Public Library	1	7
New Hampshire College of A. and M. Arts	1	5
New Hampshire Historical Society		1
New Hampshire State Library	6	
New Haven Free Public Library		1
New Jersey Agricultural Experiment Station		6
New Jersey Geological Survey	2	
New Mexico College of A. and M. Arts		1
New Orleans University		1
New Shakespeare Society, London	5	
New South Wales Department of Mines		3
New South Wales Government	3	

List of Donations to the Library—Continued.

Presented by—	Books.	Pamphlets.
New South Wales Royal Society	2	-------
New York Academy of Sciences	-------	2
New York Apprentices' Library	-------	2
New York Aqueduct Commission	1	-------
New York City Meteorological Observatory	1	8
New York City Union Club	1	-------
New York City Union League Club	1	-------
New York City University	-------	4
New York City University Club	-------	1
New York Medical College	-------	1
New York Mercantile Library	-------	1
New York State Board of Health	2	12
New York State Charities Aid Association	-------	1
New York State Library	-------	6
New York Theological Seminary	-------	1
Newman, Q., Valparaiso	1	1
North Carolina College of A. and M. Arts	-------	1
North Dakota Agricultural Experiment Station	-------	4
Northampton, Mass., Forbes Library	-------	1
Northwestern University, Wisconsin	-------	1
Nova Scotia Department of Mines	-------	1
Nova Scotia Institute of Science	-------	1
Oakland Free Library	-------	1
Oakland Health Department	-------	10
Oberlin College	-------	8
Occidental College	-------	1
Ohio College Association	-------	1
Ohio State Board of Agriculture	-------	6
Ohio State Fair	-------	1
Ohio State University	-------	14
Ohio Weather and Crop Service	-------	6
Oklahoma A. and M. College	-------	1
Olivet College	-------	1
Orcutt, C. R., San Diego	2	8
Oregon University	-------	5
Ottawa Experiment Farm	-------	1
Ozark College	-------	1
Pacific Rural Press	6	-------
Pacific Theological Seminary	-------	3
Pacific University	-------	2
Padova Università	-------	1
Paget, Prof. F. V., U. C.	1	-------
Paris Académie des Sciences	1	1
Paris Ecole Normale Supérieure	-------	1
Paris Institut de France	-------	1
Paris Museum d' Histoire Naturelle	-------	6
Patterson Free Public Library	-------	1
Peabody Institute, Baltimore	-------	1
Peckham, G. W. *and* E. G.	-------	1
Pennsylvania Prison Society	-------	1
Pennsylvania State College	1	1
Pennsylvania University	-------	5
Philadelphia Academy of Natural Sciences	-------	1
Philadelphia Bureau of Water	1	-------
Philadelphia City Institute	-------	1
Philadelphia Library Co.	-------	1
Philadelphia Mercantile Library	-------	1
Phillips Exeter Academy	-------	1
Philomath College	-------	1
Pierce, E. L.	-------	1
Pola Hydrographisches Amt.	-------	3
Pomona College	-------	1
Portland Academy	-------	1
Portland Public Library	-------	7
Prag Universität	-------	3
Prager, R. L, Berlin	1	-------
Pratapa, Chandra Ray	-------	3
Pratt Free Library	-------	2

LIST OF DONATIONS TO THE LIBRARY—Continued.

Presented by—	Books.	Pamphlets.
Pratt Institute		6
Princeton Theological Seminary		1
Princeton University		1
Providence Athenæum		2
Providence City Engineer		1
Purdue University		4
Putzker, Prof. Albin, U. C.	1	1
Pyburn, Dr. George, Sacramento		1
Queens College and University		2
Queensland Geological Survey		2
Radcliffe College		2
Randol, J. B., San Francisco (besides duplicates)	51	132
Ransome, F. L., U. C.		1
Redfield College		1
Reformed Church in America	1	
Reinstein, J. B., U. C.		2
Renssalaer Polytechnic Institute		2
Reynolds Library		1
Rhode Island College of A. and M. Arts		9
Rhode Island Historical Society		3
Rhode Island State Board of Health		1
Richardson, E. C., Princeton	2	
Richardson, Dr. G. M., U. C.	2	
Ritter, Prof. W. E., U. C.		1
Rix, E. A., U. C. 1877	1	
Rochester Academy of Sciences		1
Rochester University		1
Rodgers, Arthur, U. C. 1872	1	
Rogers, R. R., U. C. 1896	1	
Rollins College		1
Rome Reale Accademia dei Lincei		30
Rome Regia Università		1
Rose Polytechnic Institute		1
Rowell, J. C., U. C.		1
Royal Dublin Society		11
Royal Irish Academy		5
Royal Society of Canada	1	
Rush Medical School	1	
Rutgers Scientific School		11
Rutgers University		1
St. Andrews University	1	
St. Charles College		1
St. Ignatius College, Chicago		1
St. Ignatius College, San Francisco		1
St. John's College		1
St. Joseph's College		1
St. Louis Mercantile Library		1
St. Louis Merchants Exchange		1
St. Louis Public Library		1
St. Louis University		1
St. Matthew's College		1
St. Olaf's College		1
St. Petersburg Academie des Sciences		4
St. Petersburg Comité Géologique		21
St. Petersburg Hortus Petropolitanies		1
St. Petersburg Société des Naturalistes		1
St. Petersburg Université		8
Salem Public Library	1	12
San Francisco Free Public Library		8
San Francisco Health Department		12
San Francisco Mechanics Institute		2
San Francisco Theological Seminary		1
Santa Clara College		1
Santiago Sociedad Cientifique du Chili	1	3
Santiago Universidad		1
Savage, R. H., New York	1	
Searight, James A., Uniontown, Pa.	1	

LIST OF DONATIONS TO THE LIBRARY—Continued.

Presented by—	Books.	Pamphlets.
Seattle Library	-------	1
Shinn, C. H., U. C.	3	24
Shinn, Miss M. W.	2	-------
Sierra Club	-------	3
Simonds, E. H., U. C.	1	-------
Singleton, M. F., Atlanta	-------	2
Smith, A. W., Palo Alto	1	-------
Smith, Geo. H., Los Angeles	3	-------
Smithsonian Institution	3	-------
Societé Pomologique de France	-------	6
Society of Naval Architects and Marine Engineers	-------	1
Soulé, Prof. F., U. C.	-------	3
South Carolina College	-------	1
South Dakota University	-------	2
South Kensington Museum	2	3
Southern California Historical Society	-------	3
Southern University	-------	1
Southward Foundry and Machine Co.	1	-------
Spreckels, Claus, San Francisco	1	-------
Springfield City Library	-------	1
Springfield School for Christian Workers	-------	1
Stevens Institute of Technology	-------	1
Stillman, Prof. J. M., U. C. 1874	1	1
Stockholm Geologiska Foreningen	-------	1
Stockholm Vetenskaps Akademien	2	5
Strasburg Universität	3	-------
Street, A. I., U. C.	1	1
Sundara Bata Ray, Calcutta	-------	1
Sutro, Adolph, San Francisco	-------	1
Sydney Australian Museum	-------	3
Sydney Department of Mines and Agriculture	-------	2
Sydney Observatory	-------	7
Sydney University	1	-------
Syle, Prof. L. D., U. C.	1	-------
Tabor College	-------	1
Technical Society of the Pacific	-------	3
Tennessee State Board of Health	-------	6
Tennessee University	-------	1
Texas Academy of Sciences	-------	1
Texas University	-------	8
Theological Seminary, Auburn	-------	1
Thompson, C. H.	-------	1
Thompson, John, Philadelphia	-------	2
Thompson, W. D., U. C. 1895 (besides 3 duplicates)	18	-------
Tidestrom, Ivan, U. C.	-------	2
Tiflis Observatoire Physique	-------	2
Toledo Park Commissioners	-------	1
Toronto College	-------	1
Toulouse Acadamie des Sciences	2	3
Trinity College, Hartford	-------	1
Tufts College	-------	1
Tulane University of Louisiana	-------	1
Turin Observatorio in Moncaliere	-------	1
Turin Universita	-------	1
Turner, H. W., Washington	-------	3
Typothetæ of New York City	1	-------
Union Theological Seminary	-------	1
Union University	-------	1
United States, various departments	251	548
University of California, Class of 1884	1	-------
University of California, Class of 1896	2	-------
University of California, College of Agriculture	-------	6
University of California, College of Dentistry	-------	1
University of California, College of Pharmacy	-------	1
University of California, Lick Observatory	11	184
University of California, President's Office	-------	85
University of California, Recorder's Office	-------	34
University of California, Secretary's Office	2	5

LIST OF DONATIONS TO THE LIBRARY—Continued.

Presented by—	Books.	Pamphlets.
University of California, Veterinary College		1
University of Denver		1
University of the South		1
University of the State of New York	2	4
University of Washington		1
University of Wyoming		1
Upsala Universitet		30
Ursinus College		1
Utah Agricultural College		1
Utrecht Universität	1	30
Vanderbilt University		1
Van Ness Seminary		1
Vassar College		1
Vera Cruz Observatorio		6
Versailles Société d'Agriculture, etc.		2
Very, Frank W.		1
Victoria Department of Mines		1
Victoria Legislative Assembly Library	1	
Victoria Public Library	1	
Vienna Akademie der Wissenschaften	1	
Vienna Universität		5
Virginia University		1
Wabash College		2
Walker, Hon. J. H.		2
Washburn Observatory		1
Washington and Jefferson College		1
Washington and Lee University		1
Washington Engineering Commissioner		1
Washington University, St. Louis		1
Wellesley College		1
Wells College		1
Wesleyan University		1
Western College		1
Western Reserve Historical Society		2
Western Reserve University		3
White, Hon. S. M.		7
Whitman College		1
Wilder, E. M., U. C. 1894	2	
Williams College		2
Willson, Prof. Geo. G., Providence	1	
Wilson, H. M., U. C. 1896	1	
Wisconsin Academy of Sciences	1	1
Wisconsin State Historical Society	1	1
Wisconsin University		5
Woodworth, Prof. C. W., U. C.		1
Wooster University		2
Worcester, J.		1
Worcester Free Public Library		10
Worcester Polytechnic Institute		1
Worcester Society of Antiquity		4
Würzburg Universität	3	9
Wyoming Experiment Station		2
Yale University	2	10
Yerkes Observatory		1
York, R. B., Oakland		3
Zeballos, E. S., Buenos Ayres	2	
Zeno Mauvais Music Co.		2
Totals	1,870	3,503

PERIODICALS RECEIVED IN EXCHANGE OR BY GIFT.

Advocate of Peace, Agricultural Journal of Cape Colony, Altrurian, Amateur Athlete, American Economist, Annalen der Hydrographie, Annales des Mines, Appeal to Reason, Berkeley Advocate, Berkeley Gazette, Berkeley Herald, Berkeleyan, Bolletino Mensile di Bachicoltura, Book Reviews, Bowdoin Orient, Bulletin de Société Geologique de France, California Homœopath, California Medical Journal, California Orchard and Farm, California Voice, Cambridge Philosophical Society Proceedings, Catholic University Bulletin, Christian Register, Citizen, Civil Service Chronicle, Coming Nation, Contra Costa Gazette, Contra Costa News, Converted Catholic, Dental Cosmos, Erythea, Esoteric, Eusebia, Fresno Expositor, Georgetown Gazette, Hochschul Nachrichten, Human Nature, Josh, Journal of Comparative Neurology, Journal of Electricity, Journal of Geology, Journal of the Franklin Institute, Journal of the Linnean Society, Kansas University Quarterly, Labour and Copartnership, Land of Sunshine, Literary News, Los Angeles Times, Mining Industry and Review, Mining Journal, Mount Lowe Echo, National Geographical Magazine, New York Voice, Oakland Enquirer, Oakland Saturday Night, Oakland Tribune, Occident, Ojai, Our Pulpit, Pacific, Pacific American, Pacific Coast Journal of Homœopathy, Pacific Educational Journal, Pacific Medical Journal, Pacific Unitarian, People, Philatelic Californian, Populist, Post Graduate and Wooster Quarterly, Quarterly Journal of Economics, Royal Society of London Proceedings, Rural New Yorker, Sacramento Bee, Sacramento Record-Union, San Francisco Bulletin, San Francisco California Demokrat, San Francisco Call, San Francisco Examiner, San Francisco Report, San José Herald, Santa Clara, Scottish Geographical Magazine, Searcher, Searchlight, Signs of the Times, Smelter, Socialist, Sound Currency, Stone, Students Journal, Technology Quarterly, Travelers Record, University of California Magazine, Voice of Labor, Western Journal of Education, Wood and Iron, Yale Law Journal, Yale Literary Magazine, Young Men's Era.

REPORT OF THE DIRECTOR OF THE LICK OBSERVATORY.

Lick Observatory, University of California,
September 1, 1896.

To the President of the University of California:

Dear Sir: I have the honor to submit to you my ninth annual report as Director of the Lick Observatory. A copy of it has been handed to the Chairman of the Lick Observatory Committee of the Regents. The corresponding report of September 1, 1895, is printed in full at page 109 of the Report of the Secretary of the University of California, for the year ending July 1, 1895.

ORGANIZATION OF THE LICK OBSERVATORY.

Martin Kellogg	President of the University.

Edward S. Holden	Director.
Messrs. Schaeberle, Campbell, Tucker, Hussey	Astronomers.
Messrs. Colton, Aitken	Assistant Astronomers.
(Mr. Aitken is only temporarily employed.)	
C. D. Perrine	Assistant Astronomer and Secretary.

John Macdonald	Foreman and Machinist.
J. L. Bane	Carpenter.
W. W. Pauli	Janitor.
W. N. Jess, N. Soto, P. Soto	Laborers.

VISITORS.

The total number of visitors registered from June 1, 1895, to June 1, 1896, is 4,838.

The total number from June 1, 1888, to June 1, 1896, is 43,536.

STUDENTS AT MOUNT HAMILTON.

No action has been taken on the matters referred to in my report of September 1, 1895.

FELLOWSHIPS IN ASTRONOMY AT THE LICK OBSERVATORY.

The great advantage to students, and incidentally to the Observatory, which would result from the establishment of endowed Fellowships in Astronomy at the Lick Observatory, has been pointed out in one form or another in all my annual reports, as well as in other reports and places. The Fellowships should be endowed, because the mere living expenses of a student at Mount Hamilton are about $500. If we can provide for the mere expenses of living, we may expect to attract the very best class of graduate students from all over the United States. As our accommodations for students are limited, a selection of the best men of the best class can be made. Our graduate students, who would leave us at the end of a three years' course (with the degree of Ph.D. or Sc.D.), would be thoroughly grounded in their chosen profession, and their subsequent work would reflect credit upon the Observatory and the University.

The Lick Observatory Committee of the Regents, the Academic Council, and the President of the University, are, I understand, in favor of establishing such Fellowships. A plan for the purpose is now being studied by the Committee on Internal Administration. I earnestly recommend this matter to your attention. I do not see how the Observatory can do its full duty to the University, nor arrive at its own proper efficiency, unless something is done in this direction.

As a matter of history, I may say that I have used my best endeavors to obtain endowments of such Fellowships from private persons—friends of the Observatory—without much success. During the years 1892 to 1894 Mrs. Phebe Hearst gave the Observatory certain funds annually. The Hearst Fund was expended according to a memorandum prepared by me (dated March 3, 1892), and submitted to Mrs. Hearst. The first item of expenditure named in the memorandum was "the establishment of Fellowships in the Lick Observatory, which are to be known as the Phebe Hearst Fellowships of the Lick Astronomical Department of the University of California. I desire that the amount allotted to each Hearst Fellow shall never exceed $500 per annum."

No funds have been available for such purposes since January, 1894.

THE CROSSLEY REFLECTOR.

The original plans on which the Lick Observatory is now built were made by Professor Newcomb and myself in 1874, more than twenty years ago. Mr. Lick provided that his observatory should possess the most powerful telescope in the world, and the 36-inch refractor, now mounted here, fulfilled this condition. It was proposed to supplement the great refractor by a large reflector. During the years 1874 to 1887 the plan of erecting a large reflector here was constantly kept in mind. It was finally abandoned, because the available funds did not warrant the necessary expense.

Since the Observatory has been part of the University—since June 1, 1888—the need for such a telescope has been felt, especially during the past two or three years. There are certain spectroscopic and photographic researches in which the reflector has a distinct advantage over the refractor; just as the latter is superior to the former in certain other fields. The two instruments are not rivals, but coadjutors. Each has its province. One is Emperor; the other Pope.

Not only was the general question of procuring a reflector kept in view, but particular steps were taken in this direction. A certain 3-foot reflector, now happily the property of the University, was made by Mr. A. A. Common, F.R.S., in 1879, and used by him with great success. It was subsequently purchased from Mr. Common by Mr. Edward Crossley, then Member of Parliament for Halifax, himself an enthusiastic amateur of astronomy. Learning that Mr. Crossley was preparing to dispose of this reflector, I endeavored, some three years ago, to procure the money necessary to buy it for the Lick Observatory. Owing to the depression in business here, it was not then practicable to raise the requisite funds. Mr. Crossley's attention was fixed, at this time, upon the great astronomical advantages of the site at Mount Hamilton, and he at once saw that a telescope placed here would be able to render services to science far greater than those which could be expected in a climate like that of England. The Lick Observatory was also an established part of a great University belonging to a rich State; and it had already shown by its work the mettle of the competent and faithful observers who form its staff. Mr. Crossley was impressed by all the advantages named, and when it was finally proposed to him to give us his great telescope, with its apparatus and dome, outright, he most generously and liberally agreed to do so. In April, 1895, his telegram offering this gift to the Lick Astronomical Department of the University was received. His letter making the formal proposal is dated April 6th.

In order to accept this gift it was necessary to raise a sum of money to pay the cost of dismounting the telescope and dome in England, of transporting them to California, and of setting them in place ready for work at Mount Hamilton. The University being short of ready money, it seemed desirable to propose to certain representative citizens of California to subscribe to the desired fund. Accordingly, the funds necessary to the acceptance of the telescope have been obtained from subscriptions from friends of the Observatory, and, at the meeting of the Regents on April 30th, the generous gift of Mr. Crossley was definitely accepted. One word as to the contributors to the fund for installing the Crossley Reflector. Every gift to the fund was made, not only cheerfully, but with positive pleasure—all were glad to give toward an object so useful and so honorable to the State and to science. Every class of our citizens is represented. We have contributions from Regents of the University, from a member of the Academic Senate, from a member of the Alumni, from the Astronomical Society of the Pacific, from the Society of California Pioneers and the California Academy of Sciences, from bankers, manufacturers, railway officials, lawyers, men of business, capitalists—both men and women.

The heavy parts of the telescope and dome were transported free of cost from New York to San José by the kindness of the officials of the Southern Pacific Company—especially of Messrs. Towne and H. E. Huntington; the mirrors and the more delicate parts of the apparatus were transported from New York to San José free of cost by the Wells-Fargo Express Company—through the kindness of President J. J. Valentine. The United States Express Company, by its President, Thos. C. Platt, Esq., offered free transportation over its lines from New York to Pittsburg. Messrs. Percy & Hamilton, architects of San Francisco, generously made the working drawings for the dome, etc.; and Mr. Percy made three professional trips to Mount Hamilton for our benefit.

Miss Catherine W. Bruce gave the sum of $500 to provide a special spectroscope for the telescope. It is now nearly completed from designs by Professor Campbell.

The total money gifts for this purpose from friends of the Observatory have been	$5,085 00
All of this money has been or will be expended on the dome and telescope.	
The Southern Pacific Company transported the heavier parts of the dome and telescope from New York to San José, a service which would have cost	1,005 14
The Wells-Fargo Express Company transported the mirrors and delicate parts of the telescope from New York to José, a service which would have cost	323 80
From the budget of the Lick Observatory there has been disbursed for materials, etc.	782 17
Seventy-two thousand brick belonging to the University have been used in the construction of the dome, at $12 per M.	864 00
I have kept an account of the time spent by the Lick Observatory workmen on the work at the Crossley dome. Their labor, if charged at their regular wages, would amount to	1,156 33
Cost of the Bruce Spectroscope: Bruce Fund, $500; from L. O. Budget, $175	675 00
Two marble tablets presented by Vermont Marble Company	50 00
Total cost of bringing the Crossley telescope and dome from England, and setting them in place at Mount Hamilton	$9,941 44

It is very worthy of remark, that all the work of erecting the iron dome, and the complicated mounting of the telescope, was done by Lick Observatory workmen, under the direct charge of Mr. Macdonald, foreman, and Mr. Bane, carpenter, employing no expert mechanics from the outside, but laborers only. The superintendence of the work was by Mr. George W. Percy of San Francisco, Professor Hussey, and myself. I think it would be difficult to find a case where such work as this has been done with equal economy.

The gift of Mr. Crossley is a gift from a citizen of a foreign country to the State of California. It has been accepted by representative citizens, and was turned over to the care of the Regents for the use of the University. It should be a source of gratification to Californians that Mr. Crossley has chosen to make his gift to a California institution. There are many important observatories in England, in India, in the Colonies of Africa and Australia, any one of which would have been delighted to receive Mr. Crossley's magnificent present, and any one of which would have made excellent use of it. Mr. Crossley has chosen out of them all that observatory in which he considered his telescope would be most useful. I wish to point out that this gift is a striking evidence that true science is universal, and that the spirit which prompted Mr. Crossley to place his telescope where it can be used to the best advantage is high-minded and truly scientific in a marked degree. The foundation of the Smithsonian Institution, in Washington, by James Smithson, of London, and of the Royal Institution, in London, by Benjamin Thompson (Count Rumford), of Woburn, Massachusetts, are well-known instances of the spirit in which Mr. Crossley's gift was made.

To commemorate the gift to the University of California, two tablets of marble will be set up at the main entrance to the Crossley dome—inscribed as follows:

I.

THE CROSSLEY REFLECTOR,

With its dome, was presented to the Lick Astronomical Department of the University of California, in 1895,

by

EDWARD CROSSLEY, F.R.A.S.,
Of Halifax, Yorkshire, England.

II.

The Crossley Reflector was set up in this place by the following friends of the Lick Observatory:

William Alvord.
T. Ellard Beans.
Miss C. W. Bruce.
James V. Coleman.
George Crocker.
Henry J. Crocker.
J. B. Crockett.
Christian de Guigné.
Mrs. Peter Donahue.
J. A. Donohoe.
Farmers' Union.
Glenwood Lumber Co.
Charles Goodall.
Robert Y. Hayne.
Alvinza Hayward.
I. W. Hellman.
Edward S. Holden.
Edward W. Hopkins.
James P. Houghton.
C. P. Huntington.
George R. Lukens.
Charles Mayne.
Albert Miller.
D. O. Mills.
W. S. Moses.
Charles Nelson.
M. P. O'Connor.
A. H. Payson.
Percy & Hamilton.
Mrs. John Parrott, Sr.
John Parrott, Jr.
James D. Phelan.
Wm. H. Pierson.
James B. Randol.
Louis Sloss.
Southern Pacific Company.
Levi Strauss.
Lloyd Tevis.
Alex. Blair Thaw.
Union Iron Works.
United States Express Co.
Wells, Fargo & Co.
The Vermont Marble Co.

The money received from the various subscribers to the fund for installing the Crossley reflector was deposited with the Treasurer of the University and expended on requisitions approved by the President of the University, by the Lick Observatory Committee, and by the Finance Committee of the Regents. A list of the money expenditures on the Crossley dome and telescope follows. Vouchers for every item are on file at Berkeley.

The Crossley telescope and dome are now in working order. It has been found necessary to provide (from a gift of money by Miss Bruce) a new driving-clock. This is now under construction from plans by Professor Hussey.

ITEMIZED STATEMENT OF THE EXPENDITURES FROM THE FUND FOR INSTALLING THE CROSSLEY REFLECTOR AT MOUNT HAMILTON.

	1895.	Draft to Mr. Crossley (expenses of taking down the telescope in England and packing it for transportation), £200	$980 00
Req. 768—		Traveling expenses on official business	28 50
770—	May 4—	L. Bernal, hauling material	36 00
	May 4—	S. Bernal, labor	17 00
	May 4—	A. Bernal, labor	17 00
	May 4—	C. C. Chesterman, labor	18 50
	May 4—	C. Webber, labor	17 50
	May 7—	J. Wandell, hauling material	5 22
	May 9—	American Oil Co., white lead	22 37
		Freight on cement, San Francisco to San José	25 20
	May 8—	Union Lumber Co., lumber	22 90
	May 8—	Wilson Bros. & Co., lumber	62 26
	May 6—	J. D. Spreckels & Bros., cement	202 50
	May 9—	Glenwood Lumber Co., lumber and tin	32 49
		Freight on lumber, San Francisco to San José	17 58

	1895.		
Req. 773	May	11—Holbrook, Merrill & Stetson, pipe and fittings	$65 55
	May	11—J. Wandell, hauling	6 91
	May	15—L. Bernal, hauling	44 91
	May	15—J. Wandell, hauling	9 46
	May	15—J. R. Kincaid, sand	50 68
	May	16—J. R. Kincaid, hauling lime	19 68
	May	10—L. Bernal, hauling lime	17 60
	May	11—Markovits Bros., 700 sacks for sand	17 50
	May	6—Stock Sons, pipe	57 84
	May	13—Farmers' Union, shovels, handles, and steel	5 93
	May	18—J. Peterson, labor	7 50
	May	18—Otto Pauli, labor	5 00
	May	18—George Rogers, labor	8 00
	May	18—C. Filkins, labor	12 00
	May	18—T. B. Martin, labor	12 00
	May	18—L. Bernal, hauling brick	24 00
	May	18—S. Bernal, labor	24 00
	May	18—A. Bernal, labor	24 00
	May	18—C. Webber, labor	24 00
	May	18—C. C. Chesterman, labor	23 00
	May	17—L. Bernal, hauling	35 20
770	Apr.	24—Farmers' Union, powder, etc., for blasting	1 05
	Apr.	25—Farmers' Union, charcoal for blacksmith	1 50
774	May	15—Holbrook, Merrill & Stetson, 500 ft. 1½-in. pipe	46 87
	May	17—Farmers' Union, 20 bbls. lime	35 00
	May	14—Farmers' Union, 20 bbls. lime	35 00
	May	18—J. R. Kincaid, hauling 20 bbls. lime	19 46
	May	18—J. Wandell, hauling pipe and lumber	10 18
	May	17—Taber, photos of plans for architect	9 00
	Apr.	22—Borschken Hardware Co., shovels, etc.	10 10
	May	22—J. Wandell, hauling lumber	10 29
	May	20—Glenwood Lumber Co., 1,000 ft. lumber	17 00
		Void, refunded—E. B. 76,378, freight on lumber from San Francisco, $5.	
	May	24—L. Bernal, hauling lumber	39 74
	May	24—L. Bernal, hauling cement	68 80
	May	24—J. R. Kincaid, sand	23 20
	May	24—G. Bernal, hauling cement	17 60
	May	25—C. C. Chesterman, labor	12 00
	May	25—C. Webber, labor	12 00
	May	25—A. Bernal, labor	12 00
	May	25—S. Bernal, labor	12 00
	May	25—T. B. Martin, labor	12 00
	May	25—C. Filkins, labor	12 00
	May	25—George Rogers, labor	9 50
	May	25—Otto Pauli, labor	12 00
	May	25—J. Peterson, labor	16 50
770	May	23—Stock Sons, rings for transp. frames	50
773	May	27—L. Bernal, hauling	56
	May	25—Farmers' Union, nails	2 20
	May	29—Farmers' Union, powder and fuse	2 00
774	May	29—J. Wandell, hauling	6 00
	May	31—L. Bernal, hauling	30 04
	June	1—F. G. Radelfinger, labor	9 33
781	May	24—D. C. & H. Co., 3-in. pipe	71 49
	May	31—Mrs. B. Bernal, hauling	12 00
	June	1—C. C. Chesterman, labor	8 44
	June	1—C. Webber, labor	8 44
	June	1—T. B. Martin, labor	8 00
	June	1—A. Bernal, labor	8 44
	June	1—S. Bernal, labor	8 44
	June	1—G. Rogers, labor	8 44
	June	1—O. Pauli, labor	9 55
	June	1—C. Filkins, labor	8 00
	June	1—P. Peterson, labor	10 00
	June	1—L. Bernal, hauling brick	12 00
	June	3—J. Wandell, hauling lime	5 76
	June	4—C. C. Chesterman, labor	4 00
	May	31—D. Rinaldo, picture moulding, for framing Mr. Crossley's portrait and plans	2 00
	May	31—W. U. T. Co., telegrams	1 26
	June	1—Farmers' Union, hoop-set	85
	June	6—J. Wandell, hauling	9 88
		S. P. Co., E. B. 77,250, freight to San Francisco	25
	June	4—Glenwood Lumber Co., lumber	23 00
	June	8—L. Bernal, hauling	2 82
		S. P. Co., E. B. 78,723, freight from San Francisco	25

	1895.		
Req. 781	June 8	C. Webber, labor	$4 00
	June 8	O. Pauli, labor	14 00
	June 8	P. Peterson, labor	17 00
	June 8	F. G. Radelfinger, labor	12 00
	June 8	L. Bernal, hauling brick	32 00
	June 8	W. W. Bent, labor	22 50
	June 8	E. A. Leddy, labor (brick mason)	27 50
	June 8	F. Gardiser, labor (brick mason)	27 50
	June 8	G. Gardiser, labor (brick mason)	27 50
	May 27	Pacific Tank Co., tanks and freight	280 35
	June 4	Farmers' Union, 6 bbls. lime	10 50
	June 15	W. W. Bent, labor	27 00
	June 15	E. Leddy, labor	33 00
	June 15	F. Gardiser, labor	33 00
	June 15	G. Gardiser, labor	33 00
	June 15	F. G. Radelfinger, labor	12 00
	June 15	P. Peterson, labor	18 00
	June 15	O. Pauli, labor	4 00
	June 15	C. Webber, labor	4 00
	June 15	J. R. Kincaid, sand	22 76
	June 15	C. Webber, labor	4 00
	June 12	Farmers' Union, 4 bbls. lime	7 00
	June 5	Stock Sons, tank fittings	25 73
	June 18	J. Wandeli, hauling	4 24
	June 11	Stock Sons, pipe fittings	1 55
	June 17	Farmers' Union, 1 keg nails	2 80
	May 10	S. P. Co., unloading lumber	3 00
	June 22	W. W. Bent, labor	27 00
	June 22	E. Leddy, labor	33 00
	June 22	F. Gardiser, labor	33 00
	June 22	G. Gardiser, labor	33 00
	June 22	P. Peterson, labor	18 00
	June 22	F. G. Radelfinger, labor	12 00
	June 18	Glenwood Lumber Co., lumber	22 41
	June 20	Farmers' Union, keg nails	2 75
	May 15	Stock Sons, pipe fittings	5 09
	June 23	J. Wandell, hauling	7 20
	June 29	L. Bernal, hauling	44 02
	June 29	W. W. Bent, labor	27 00
	June 29	E. Leddy, labor	33 00
	June 29	F. Gardiser, labor	33 00
	June 29	G. Gardiser, labor	33 00
	June 29	P. Peterson, labor	18 00
	June 29	F. G. Radelfinger, labor	12 00
	June 28	Farmers' Union, 2¾ doz. washers	17
	July 1	Mangrum & Otter, copper strip, 12′ x 4″, for lightning rod	3 50
	July 1	J. Wandell, hauling 2,400 brick	4 80
	June 27	Glenwood Lumber Co., lumber for scaffolding	33 50
	July 3	J. Wandell, hauling 5 bbls. lime	4 80
	July 2	Farmers' Union, 5 bbls. lime	8 75
	July 6	F. Gardiser, labor	33 00
	July 6	W. W. Bent, labor	15 75
	July 6	F. G. Radelfinger, labor	8 00
		Golden West Iron Works, iron-work	54 91
791	June 29	Forderer Cornice Works, galvanized iron gutter, etc.	146 75
	July 5	Keating, Leonard & Ransome, twisted iron, bolts, etc.	51 70
	July 5	Miller & Hamilton, window and door frames, etc.	153 30
	July 6	J. R. Kincaid, sand and gravel	28 56
	July 13	F. Gardiser, labor	33 00
	July 13	F. G. Radelfinger, labor	12 00
	July 13	W. W. Bent, labor	27 00
	July 9	J. Wandell, hauling	4 82
		S. P. Co., E. B. 82,414, freight on doors, etc., from San Francisco	30
	July 20	F. G. Radelfinger, labor	12 00
	July 20	W. W. Bent, labor	27 00
796	July 18	Ross & Sons, hauling mirrors, etc.	24 00
	July 22	J. R. Kincaid, sand and gravel	12 04
	July 22	J. H. Riechers, labor (cement-man)	50 00
	July 22	J. Wandell, hauling freight	4 08
774	July 23	F. G. Radelfinger, labor	(2 00)
796	July 23	F. G. Radelfinger, labor	2 00
	July 23	W. W. Bent, labor	9 00
	July 23	J. R. Kincaid, labor, screening sand	7 50
	July 17	F. Gardiser, labor	16 50
781	July 20	Glenwood Lumber Co., lumber	(4 80)
791	July 20	Farmers' Union, acid and charcoal	(3 10)

	1895.		
Req. 796	July 23	General Electric Co., fittings for finder	$27 50
	Aug. 7	L. Bernal, hauling telescope mounting	59 00
	July 17	Westerman & Co., insurance, charges, and com., in N. Y.	60 00
808	July 25	S. P. Co., charges, etc., on telescope in New York	11 40
	Aug. 20	W. W. Montague & Co., 2 iron washbasins for offices and dark room	8 10
	Aug. 27	S. P. Co., charges, etc., on dome in New York	23 07
	Sept. 1	S. P. Co., charges, etc., on dome in New York	7 18
		Mangrum & Otter, 8 days' work of tinner, etc.	37 95
	Sept. 7	W. N. Jess, board of tinner, $7; tallow, 25c.	7 25
	Sept. 1	Ross & Sons, stage fare of tinner	3 00
	1896.		
846	May 6	E. Gray, 2½ days' labor, at $1 75	4 38
	May 9	O. Pauli, 4 days' labor, at $2	8 00
	May 15	Brassy & Co., 3 gals. alcohol, at $3	9 00
	May 13	Farmers' Union, 4 whitewash brushes	40
	May 15	Farmers' Union, 10 lbs. lampblack	1 50
	May 14	Cherrie & Co., 1 piece galvanized wire cable	50
	May 25	Brassy & Co., 1 gal. alcohol	3 00
	May 28	Mangrum & Otter, plumbing connections	4 70
	May 30	Brassy & Co., 2 gals. alcohol	6 00
	June 2	Brassy & Co., 2 gals. alcohol	6 00
	May 22	Cherrie & Co., hardware for dome	9 15
	May 26	Cherrie & Co., hardware	2 45
	May 30	Glenwood Lumber Co., 250 ft. 1¼″x 4″ flooring	6 25
	May 25	Glenwood Lumber Co., 250 ft. 1″x 4″ flooring	6 25
	June 3	Farmers' Union, 23 lbs. putty	81
	June 9	J. Wandell, hauling freight from San José	1 06
	June 25	J. R. Kincaid, 2.23 cu. yds. sand	8 92
		Total	$4,953 36

MATERIALS FOR CROSSLEY DOME CHARGED AGAINST LICK OBSERVATORY BUDGET ON LICK OBSERVATORY REQUISITIONS.

Req. 806	Hauling dome from San José to Lick Observatory	$225 75
810	Expenses of Customs Officers—inspecting Crossley Telescope	14 00
812	Four cubic yards sand	16 00
818	New bed-plate for telescope	150 00
821	Labor and materials	250 00
823	Fire bell	15 00
831	Hauling bolts. (In Wandell's bill of $3 18)	50
828	Freight on Crossley Bell from San Francisco	25
828	Hauling bell to Lick Observatory. (In Wandell's bill of $5 04)	24
837	Materials and fittings for the dome	100 00
834	Telegram to workman (O. Pauli)—March 25th	25
834	Two telegrams to J. A. Brashear—March 24th and 26th	2 28
834	Express charges on spectroscope drawings to Brashear—April 7th	1 60
847	Telegram to Union Iron Works, San Francisco—April 2d	59
847	Telegram to J. Caire, San Francisco—April 25th	27
849	Hauling lumber from San José to Lick Observatory. (In Wandell's bill of $5 50)	2 94
849	Hauling rivets to San José. (In Wandell's bill of $5 50)	1 00
859	Felt for large mirror	1 50
	Total	$782 17

CROSSLEY FUND (BRUCE SPECTROSCOPE FUND).

Req. 805	Apr. 6	C. F. Marwedel, brass, etc	$1 45
	Apr. 29	J. Caire Co., Scotch stone	35
	Apr. 30	Wells, Fargo & Co., express charges	1 45
	Apr. 30	P. Urmy, work on spectroscope, April 15th to 30th	32 00
	Apr. 25	C. F. Marwedel, brass, steel, etc.	2 60
	Apr. 13	C. F. Marwedel, screws and drills	1 45
	May 9	Nordman Bros., saw blades, emery paper, and postage	39
	May 30	P. Urmy, work for May	60 00
	June 8	Whyte & DeRome, four brass castings and turning	1 75
	June 12	Ingalls & Stock, two dozen saw blades	35
	June 30	Wells, Fargo & Co., express charges	8 50
	June 30	Ross & Sons, hauling express	70
	June 30	Western Union Telegraph Co., telegrams	3 54
	June 30	P. Urmy, work for June	60 00
		J. A. Brashear, prisms, collimator, camera, etc., estimate "A"	180 00
		Total	$354 53

THE CROCKER PHOTOGRAPHIC TELESCOPE.

Two photographic lenses are now available so that they can be used side by side on the Crocker mounting. It is hoped that they can be installed in a new building to be placed just north of the Crossley dome. The present Crocker dome can then be used to cover the Floyd photographic refractor, and the small dome on the summit, which is badly placed and much out of repair, can be taken down and done away with. It was built in 1879, and is of little use.

TOTAL SOLAR ECLIPSE OF AUGUST, 1896.

The liberal gift of Col. C. F. Crocker permitted the sending of a strong eclipse party to Japan (four observers). The sky was wholly cloudy, and no results were obtained. This is most unfortunate. We may, however, find some consolation in the fact that the successful observations of the Lick Observatory eclipse parties of January, 1889, December, 1889, and April, 1893, will be long remembered.

WORK OF THE ASTRONOMERS OF THE LICK OBSERVATORY.

The list of publications of the astronomers of the Lick Observatory, and the list of works issued and to be issued by the Lick Observatory, immediately following, will give an idea of the work which has engaged the astronomers of the Observatory during the past year. It remains, in general, such as has been described in previous reports.

WORKS ISSUED BY THE LICK OBSERVATORY.

It is intended to issue, at irregular intervals, two series of works, the first, in quarto, to be known as *Publications* of the Lick Observatory; the second, in octavo, to be known as *Contributions* from the Lick Observatory. Occasional pamphlets, such as Nos. 2 and 8A below, may not be included in either series. At the end of every book, a list of all the works issued will be given, for the convenience of librarians and others.

These works are not for general distribution, but for exchange with Observatories, Academies of Science, etc., in return for their publications. The *Publications of the Astronomical Society of the Pacific* contain *Notices from the Lick Observatory*, prepared by members of the staff, in each issue.

1. *Publications* of the Lick Observatory of the University of California, prepared under the direction of the Lick Trustees by Edward S. Holden. Volume I, 1887. Sacramento, 1887. 4to. [Containing a brief history of the Observatory, with descriptions of the buildings and instruments; observations of double stars by S. W. Burnham, 1879, of the transit of *Mercury*, 1881, by Messrs. Floyd, Holden, and Burnham, of the transit of *Venus*, 1882, by D. P. Todd; meteorological observations, by T. E. Fraser, 1880-85; and Reduction Tables for Mount Hamilton, by G. C. Comstock.] [Out of print.]

2. Suggestions for Observing the Total Eclipse of the Sun on January 1, 1889, by Edward S. Holden. Printed by authority of the Regents of the University of California. Sacramento, 1889. 8vo. [Out of print.]

3. *Contributions* from the Lick Observatory, No. 1. Reports on the Observations of the Total Eclipse of the Sun of January 1, 1889, published by the Lick Observatory. Printed by authority of the Regents of the University of California. Sacramento, 1889. 8vo. [Out of print.]

4. *Contributions* from the Lick Observatory, No. 2. Reports on the Observations of the Total Eclipse of the Sun, December 21-22, 1889, and of the Total Eclipse of the Moon, July 22, 1888, to which is added a Catalogue of the Library, published by the Lick Observ-

atory. Printed by authority of the Regents of the University of California. Sacramento, 1891. 8vo. [Out of print.]

5. *Contributions* from the Lick Observatory, No. 3. Terrestrial Atmospheric Absorption of the Photographic Rays of Light, by J. M. Schaeberle, Astronomer in the Lick Observatory. Printed by authority of the Regents of the University of California. Sacramento, 1893. 8vo. [Out of print.]

6. *Publications* of the Lick Observatory of the University of California. Printed by authority of the Regents of the University. Volume II, 1893. Sacramento, 1893. 4to. [Containing double-star observations made with the 36-inch and 12-inch refractors of the Lick Observatory from August, 1888, to June, 1892, by S. W. Burnham.]

7. *Publications* of the Lick Observatory of the University of California. Printed by authority of the Regents of the University. Volume III, 1894. 4to. [Containing drawings and photographs of the Moon by Professor Ladislas Weinek, reproduced in heliogravure, etc., from negatives made at the Lick Observatory, with an introduction by Edward S. Holden; investigation of prisms of optical glass, by Professor C. S. Hastings; investigation of the glass scale of the Lick Observatory measuring engine, by Mr. O. H. Tittman; spectroscopic observations of nebulæ, by Professor J. E. Keeler.] [Out of print.]

8. *Contributions* from the Lick Observatory, No. 4. Report on the Total Eclipse of the Sun, observed at Mina Bronces, Chile, on April 16, 1893, by J. M. Schaeberle, Astronomer in the Lick Observatory. Printed by authority of the Regents of the University of California. Sacramento, 1895. 8vo.

8A. A brief account of the Lick Observatory of the University of California, prepared by order of the Regents of the University, by Edward S. Holden. 1st edition, Berkeley, The University Press, 1894; 2d edition, Sacramento, 1894. 8vo. 32 pp. Stereotyped.

9. *Contributions* from the Lick Observatory, No. 5. Meteors and sunsets observed by officers of the Lick Observatory in 1893, 1894, and 1895, by Messrs. Holden, Schaeberle, Colton, and Perrine. Printed by authority of the Regents of the University of California. Sacramento, 1895. 8vo.

10. A Cipher-Code for Astronomical Telegrams, by Edward S. Holden. (Reprinted from the *Publications of the Astronomical Society of the Pacific*, No. 49. Vol. VIII.) San Francisco, 1896. 8vo.

11. Mountain Observatories in America and Europe, by Edward S. Holden. *Smithsonian Miscellaneous Collections*, No. 1035. (Illustrated.) 1896. 8vo.

Other volumes are in preparation (some being nearly ready for the press), as follows:

1. Photographs of the Milky Way, Nebulæ, and Comets, by Professor Barnard.
2. Catalogue of 38,000 Stars reduced from Washington Zone Observations, by Professors Holden and Aitken.
3. Meridian Circle Observations of Standard Stars, by Mr. Tucker.
4. Meridian Circle Observations of Struve Stars and Coast Survey Stars, by Professors Schaeberle and Aitken.
5. Meteorological Observations taken at the Lick Observatory 1888–1896, reduced by Mr. C. D. Perrine.
6. Observatory Moon Atlas from negatives taken at the Lick Observatory, by Messrs. Holden, Colton, Perrine, and others. Sheet 1 is now in the press.
7. The Lick Observatory. A chapter in the Memorial Volume to James Lick—prepared by E. S. Holden.

LIST OF PUBLICATIONS OF THE LICK OBSERVATORY ASTRONOMERS IN PERIODICALS DURING THE TWO YEARS, SEPTEMBER 1, 1894, TO SEPTEMBER 1, 1896.

This list will be found at the end of the report of the President of the University for 1894–96. More than one thousand contributions to periodicals have been made by astronomers and students of the Lick Observatory since 1888.

NEW APPARATUS FOR THE LICK OBSERVATORY.

The general instrumental equipment of the Observatory is admirable. Its chief wants have been in minor pieces of apparatus to be used with the telescopes so as to utilize them to the best advantage. These have been gradually supplied, usually by the gifts of friends of the Observatory. Among the pieces of apparatus made, or to be made, the most important are:

The Mills Spectroscope; a powerful photographic spectroscope, given by Hon. D. O. Mills, for use with the 36-inch equatorial.

The Bruce Spectroscope; a spectroscope made from a fund given by Miss C. W. Bruce, in 1895, for use with the Crossley reflector. This instrument, now nearly finished, has been made at Mount Hamilton, from designs by Professor Campbell.

The Bruce Comet-Seeker; a 6½-inch comet-seeker to take the place of the 4-inch comet-seeker, which is deficient in light-gathering power. The mounting for this instrument will be made at Mount Hamilton, from designs by Mr. C. D. Perrine.

The Bruce Photometers; these instruments (after two designs by Professor Pickering) will be adapted for measurements of the light of variable stars, etc., with the 36-inch telescope. They were much needed, as we have had no apparatus of the sort previously.

The Bruce Clock of the Crossley Reflector; the driving-clock of the Crossley reflector was found to be deficient in power, and it will be replaced by a heavier instrument, to be made at Mount Hamilton, from designs by Professor Hussey.

The three last-named instruments will be provided from a fund given by Miss Bruce, in 1896.

It is to be noticed that a number of these instruments are to be made, either wholly or in part, at Mount Hamilton, from designs by the astronomers who are to use them. This is the only way in which instruments can be made cheaply and satisfactorily. Every observatory should have an instrument-maker permanently employed, and most are so provided. At Mount Hamilton we have used our own mechanics (unskilled in such work), and the astronomers themselves have done a considerable part of the mechanical work. The saving in time, and especially in money, has been very marked.

CENTENARY OF THE BIRTH OF JAMES LICK.

James Lick was born on August 25, 1796. The centenary of his birth was kept as a holiday at Mount Hamilton, and accounts of the work of the Observatory which he founded were sent to the California newspapers.

A very suitable way of commemorating this day would be to distribute medals bearing his effigy and an appropriate inscription.

HONORARY DEGREES, ETC., CONFERRED ON ASTRONOMERS OF THE LICK OBSERVATORY.

The decoration of the Order of the Liberator (Order of Bolivar) was conferred on the Director of the Lick Observatory, for services to science, by the President of the Republic of Venezuela, February 24, 1896.

At the last commencement of the University of the Pacific, the honorary degree of Sc.D. was conferred on the Director.

The President of the United States appointed Professor Holden a member of the Board of Visitors to the United States Naval Academy, in June, 1896.

WATER-SUPPLY; PRECAUTIONS AGAINST FIRE, ETC.

During the past year a reservoir of 25,000 gallons just below the summit level has been provided (paid for out of the Crossley Fund). It is now available for fire protection at the Crossley dome and the adjacent cottages, and will be used to provide power to move the dome, if necessary.

Two new tanks have been placed at Copernicus to provide power for the Great Dome and for fire protection.

The whole fire system has been overhauled, and is in a satisfactory condition.

The remarks made in my last report on the attic of the Main Building and on the protection of the Great Dome still hold good without change.

PLANTING TREES ON THE RESERVATION.

I earnestly urge this matter upon your attention. We now know what trees will thrive here, thanks to experiments by the Agricultural Department of the University and by ourselves. If the Lick Trustees had proceeded in this respect, we should already have a situation much better suited for astronomical observation, and far more sightly to the eye. If a forestry station were to be established here, its expenses would be small, and its results would be valuable to the State at large, and particularly so to the Observatory. To establish such a station requires a simple authorization from the Regents. I understand that Dr. Hilgard is in favor of this extension of his work.

IMPROVEMENTS IN FUTURE YEARS.

The following improvements will probably be considered necessary in future years. They are certainly to be desired whenever the income of the University will justify them. The grounds, and the reservation generally, should be improved by building new roads and trails, fencing, planting trees, etc. If the reservation of 2,600 acres should be treated by the State as a public park, its great natural variety and beauty would be appreciated by the citizens of California and by the hosts of visitors from the East and Europe. The establishment of a forestry station on the reservation appears to be the first step to be taken.

Sooner or later a good part of the present brick house on the Summit will be required for offices and laboratories, and new quarters must be built. A new barn, with quarters for three laborers, is very much needed now. A larger carpenter-shop is wanted, with room for the storage of lumber, which has heretofore been kept in the basement of the Great Dome. Many of the officers and employés have no suitable woodsheds for their winter supply of fuel. A new dome to cover the Crocker photographic telescope should be built near the Crossley dome. Most of the smaller buildings named above can be erected from materials bought from the annual budgets and by the labor of our own men. It will probably be necessary to burn a small kiln of brick shortly, in order to have brick on hand for the repairs of reservoirs, chimneys, etc.

PURCHASE OF ADDITIONAL LAND FOR THE LICK OBSERVATORY RESERVATION.

In order to complete the reservation of the Lick Observatory, it will be necessary to purchase several small parcels of land whenever they can be obtained. When these are obtained the reservation will have its proper rectilinear boundaries; the Observatory will be forever secured from surroundings which will interfere with its astronomical observations; it will be forever provided with a sufficient supply of fuel, etc. One of these parcels of land is the N.E. $\frac{1}{4}$ of Sec. 3. During the past year the S. $\frac{1}{2}$ of the N.E. $\frac{1}{4}$, which had been occupied by private owners since 1881, was suddenly thrown into the market. As it was impossible to secure this parcel through the ordinary methods of business of the University, I myself purchased it and at once reported the purchase to the Lick Observatory Committee of the Regents, offering it to the University at the price I had paid. The matter of the purchase of this land for the University is now before the Regents. It is probable that the other needed pieces of land can be secured within a few years at a very moderate cost. The reservation is none too large to secure the Observatory against intrusion, and to insure that its astronomical observations shall not be interfered with by electric lights, manufactories, etc.

PHOTOGRAPHS OF THE MOON WITH THE 36-INCH REFRACTOR.

Our negatives continue to be sent to the Observatory of Prag, where Professor Weinek is enlarging them to make a map on the scale of ten feet to the moon's diameter.

A small and handy atlas on a scale of three feet to the diameter is much wanted, also.

A gift of money from W. W. Law, Esq., of Scarboro'-on-Hudson, has made it possible to begin the publication of an Observatory atlas of the moon (on a three-foot scale) from negatives made at the Lick Observatory. The sheets of this atlas will be issued as fast as practicable. I think it will be found to be precisely what is wanted by the practical astronomer.

All the work in the photographic laboratory has been done by Mr. Colton. Mr. Colton, Mr. Perrine, and myself have done the work in the dome.

REDUCTION OF PROFESSOR SCHAEBERLE'S OBSERVATIONS OF STRUVE AND COAST SURVEY STARS.

In my report of 1894 the observations of these stars was spoken of, and the work of reduction already accomplished by Messrs. Tucker, Campbell, Leuschner, and by computers in the East (who have been paid $860) was described.

Professor R. G. Aitken, Assistant Astronomer, took the reduction sheets at the point where they were left by former computers, and has spent the time from August 1, 1895, to August 1, 1896, on the work. The sheets, which are in great part completed, will now be turned over to Professor Schaeberle for revision and discussion, and the catalogue prepared for printing.

REDUCTION OF PROFESSOR SCHAEBERLE'S OBSERVATIONS AT LICK OBSERVATORY FOR THE DETERMINATION OF THE REFRACTION.

The observations of this work have all been completed for some years. Nothing has yet been done in the reductions. I have applied to the Smithsonian Institution for aid in this latter work; so far, without success. This work should be completed and printed as soon as practicable.

PROFESSOR BARNARD'S PHOTOGRAPHS OF THE MILKY WAY, COMETS, ETC., MADE WITH THE WILLARD LENS, 1889-1895.

I understand that this work is practically completed. Professor Barnard has applied to have these negatives published by the Observatory in the regular Publications. I beg to recommend this publication, if the necessary funds can be obtained. (Professor Barnard's estimate of the cost of the plates is from $1,500 to $2,500.)

CATALOGUE OF 38,000 STARS, BY PROFESSOR E. S. HOLDEN.

This catalogue was nearly completed when I brought it to California in 1886. Since that time I have not been able to find the time to proceed with it; nor to assign any one to the work. The services of Professor Aitken are now available from August 1, 1896, to July 1, 1897 (when the period for which he was appointed terminates). It is hoped that this large catalogue may be prepared for publication during the present academic year. It will make three volumes octavo, or two in quarto.

PHOTOGRAPHS OF THE SUN.

Daily photographs of the sun were made by Mr. C. D. Perrine from July 8, 1893, to April 27, 1896, and about 1,700 negatives were secured in this time. Mr. Colton has taken this work since April 27, 1896. It should be continued for 11½ years if we are to obtain complete data. Every negative should be measured; the position and area of each sunspot should be determined; and a complete discussion of the data thus derived should be made and published. The necessary work would require the continuous services of one computer. No one is now available for this work. If it is possible, a computer should be provided.

Experiments with the 36-inch telescope on photography of the sun are now in progress, using a special piece of apparatus presented to the Lick Observatory by Dr. A. Blair Thaw, of Santa Barbara.

PAY OF THE ASTRONOMERS OF THE LICK OBSERVATORY.

Two of the Astronomers of the Lick Observatory now receive $2,400 per year, and two $2,000 per year. I respectfully recommend that all be placed on an equal footing so soon as the finances of the University shall permit.

PERMANENT APPOINTMENT OF AN ASSISTANT ASTRONOMER.

Professor R. G. Aitken, M.A. (Williams College), formerly head of the Department of Astronomy and Mathematics at the University of the Pacific, spent two summers at the Lick Observatory as a special student, thus familiarizing himself with practical work. At the same time he carried on theoretical studies, which have resulted in his calculation of the orbits of comets, etc. During the fiscal year last past it was possible to offer him the (entirely inadequate) sum of $600 for his services. This offer was accepted. He resigned his professorship in the University of the Pacific, and he was appointed Assistant Astronomer here on August 1, 1895. Until August 1, 1896, his work has consisted in—

1. Observations of a selected list of double stars with the 12-inch equatorial; 391 observations have been made to date.

2. Observations to determine the division-errors of the Meridian Circle, as assistant to Mr. Tucker; 14,400 microscope readings have been made and reduced by him in this research.

3. Reduction of Professor Schaeberle's Meridian Circle observations of Struve stars and Coast Survey stars. Twelve months were spent in this work, which is nearly completed.

4. Meteorological observations. He has been charged with the meteorological observations of the Lick Observatory (tri-daily) from January 1, 1896, to date.

5. Observations of comets, as follows: Comet *c* 1895, observations on seven nights; comet *d* 1895, observations on eleven nights; comet *b* 1896, observations on twelve nights

For the year ending July 1, 1897, we were able to offer Professor Aitken the salary of $800. He has again accepted this sum, which is very considerably less than his work should command. During the coming year Professor Aitken's work will be:

1. Observations of double stars, as before.

2. Observations of a long list of Meridian Circle stars, as assistant to Mr. Tucker. By the coöperation of two observers it will be possible to finish the observation of this list in one year. Mr. Tucker working alone would require at least two years, and probably longer, to complete the list.

3. Reduction of Professor Holden's Zone Catalogue of 38,000 stars. This work will extend throughout the entire year.

4. Meteorological observations.

5. Observations of comets.

It will be obvious that the work upon which Mr. Aitken is engaged is of a high class, demanding special skill and knowledge and thorough fidelity. His past work has shown that he is possessed of the qualities which are needed in such investigations, and that his services should be retained. I most earnestly recommend that Professor Aitken be reappointed Assistant Astronomer on July 1, 1897, at a salary of $1,200 per year. In this recommendation all his colleagues at Mount Hamilton would join.

MONEY GIFTS TO THE LICK OBSERVATORY.

In the last report of the Secretary of the University, a list of gifts of apparatus and money to the Lick Observatory during the years 1888–1895 is given. The present paragraph continues the list to September 1, 1896.

Money gifts, etc., 1888–1895, previously reported	$39,593 80
The Wells-Fargo Express Co. transported the two large mirrors and the finer parts of the Crossley Reflector, weighing 2,200 pounds, from New York to San José, free of cost	323 80
(Through an error, this item was reported last year as $383.)	
Subscriptions to the Crossley Fund since my last report* (contributed by Farmers' Union, M. P. O'Connor, G. R. Lukens)	250 00
1895—Sept.—Southern Pacific Company, hauling girders for Crossley Dome, New York to San José, free, 9,405 lbs.	176 34
Oct. 15—5-inch photographic telescope, given by Miss H. A. L. Floyd	500 00
Sept. 30—A fund raised by Professor Barnard for providing illustrations of his Milky Way and Comet photographs for a volume of Lick Observatory Publications	? ? ?
1896—A fund given by Regent Crocker to defray the expenses of an expedition to observe the total solar eclipse of August, 1896—	
Jan. 19—First installment	1,500 00
May—Second installment	1,000 00
Fund given by W. W. Law, Esq., to issue an atlas of the moon from Lick Observatory negatives †	1,300 00
August 4—A fund given by Miss C. W. Bruce to provide two photometers, a new comet-seeker, etc.	1,000 00
Total	$45,643 94

EXHIBIT OF THE ANNUAL EXPENSES OF THE LICK OBSERVATORY.

I especially invite your attention to the following summary. During the fiscal year ending July 1, 1896, the budget apportionment for the Lick Observatory was $5,500. This is considerably less than one per cent of its first cost, $610,000. This annual income was expended for the following purposes:

Supplies (packing for engines, small tools, materials, zinc, iron, wire, negative cases, glass, janitor's supplies, lamps, lanterns, paper, twine and rope, stable supplies, blacksmith supplies, carpenter's hardware, etc.)	$464 45
Incidental labor (cleaning astronomical clocks, etc.)	26 75
Unclassified expenses (shoeing mules, repairs to Lick Observatory wagons, etc.)	63 48
Oil, candles (for Lick Observatory use)	109 30
Woodcuts, etc., to illustrate Lick Observatory Publications	69 85
Water-supply (new pump, valves, etc.)	310 75
Freight and hauling	324 14
(Usually from San José at $8 a ton for slow freight; at $20 a ton by the stages.)	
Photographic supplies (plates, plate-holders, chemicals, apparatus)	798 10
(N. B.—Plates to the value of $426 are now on hand and in store.)	
Telegraph and telephone line (supplies and repairs)	84 54
Telegrams and telephone messages sent and received	49 96
(The telegrams are usually announcements of astronomical discoveries, observations; the telephone messages are usually on business connected with the Lick Observatory.)	
Expressage (books and parcels sent and received)	117 25
Postage (including postage on Lick Observatory Publications distributed by mail)	235 00
Stationery (of all kinds, blank books, observing books, wrapping paper)	198 40
Crossley Dome (miscellaneous expenses for supplies, labor, materials used in the construction of the dome)	776 73
Library (books, etc., purchased during the year)	70 94
Library (subscription to periodicals)	64 29
Library (binding books)	141 35
Scientific apparatus purchased	25 00
(A circle for measuring solar photographs; electric attachment for standard clock.)	

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* $50 of this is not yet received, but will shortly be paid in.

† $650 was paid July 10; the balance will be paid in six months.

Paints, etc. (for Lick Observatory buildings)	$199 55
Lumber (for repairs to buildings)	296 87
Iron pipe and fittings (for water-supply of the Lick Observatory)	183 77
Fire hose (to supply the place of worn-out hose)	22 00
Fuel (for engines and heating)	400 00
($221 18 worth of this wood was sold to the officers and employés at cost price.)	
Hay and barley (for Lick Observatory mules)	128 43
Photographic lenses (two)	162 80
Furnishing two rooms for Regents	57 60
Official traveling expenses	8 25
Matting for floors in Lick Observatory	90 00
Extra printing for Lick Observatory	20 00

We may summarize the above table, as follows:

Scientific apparatus purchased during the year	$25 00
Library, all expenses, including binding	276 58
Photographic supplies for scientific use	798 10
Photographic lenses (two)	162 80
Total for scientific uses	$1,262 48
The balance of the apportionment was employed in the mere care of the buildings and property	4,237 52

Photographic plates to the value of about $426 are now on hand and in store.

It thus appears that about four fifths of the entire budget was expended on the care of the buildings and equipment, and that it was only practicable to spare the sum of $1,200 for what may be called purely scientific purposes.

The object of the Lick Observatory is defined by Mr. Lick in his deed of trust of 1875: "It shall be made useful in promoting science," or in other words it is to be primarily an observatory of research. The Regents have adopted this view.

It is clear from the foregoing summary that the sum expended in research—to promote science—was inadequate to the purpose. The same conclusion would be reached by analyzing the expenditures of each and every year since June 1, 1888. The chief money support of the scientific work of the Observatory has been derived from the gifts of private persons—friends of the Observatory. These have amounted in money and instruments to $45,643 94 for the eight years, 1889–1896, or an average of $5,705 per year additional to the $1,200 (more or less) which could be annually saved from the budget for purely scientific uses. Even with the sum of $6,900 available we have been much cramped in our work. For example, this is the first year, since 1888, when we have had a sufficient number of photographic plates for use in experiments beyond our regular routine work. Each astronomer has felt the lack of money for scientific appliances in his own department, and it is only by good will and mutual coöperation that it has been possible to go on as well as we have. Most of the larger wants are now provided as I have said (usually by gifts from friends of the Observatory), and I think that the sum of $3,500 per year will provide, in the future, for our scientific needs, if we can have an instrument-maker permanently employed. The scientific wants are the most important, and should be first considered. An experience of nearly nine years has shown that it will require about $4,000 per year to keep the buildings and property in good order and repair. I recall the fact that their first cost was over $600,000, and that every want felt in a great city—for water-supply, fuel, light, heat, electricity, etc.—has to be provided for here. And everything that is provided depends upon the employés of the Observatory. We can call in no outside help. The money outlay ($4,000) is only kept so small as it is, because the five workmen of the Observatory have been trained to do any and all kinds of work—painting, plumbing, brick-laying, pipe-fitting, carpenter-work, machine-work, running of steam engines, charging and care of electric batteries, laying cement floors and walks, etc. We cannot do with fewer, or with less-skilled workmen.

The budget of the Lick Observatory should, in this way, be $7,500 per year. About $3,500 of this sum will be needed for scientific uses; about $4,000 will be required to keep the buildings and property in repair.

The salaries now paid to the regular force of the Observatory are:

Messrs. Holden, Schaeberle, Campbell, Tucker, Hussey	$13,800 00
Messrs. Colton and Perrine, Assistant Astronomers (N. B.—Mr. Colton also receives pay from the United States as Postmaster.)	2,520 00
Workmen: to Messrs. Macdonald, Bane, Pauli (janitor), Jess, N. D. Soto, P. Soto	4,120 00
Total salaries to the permanent force as now paid	$20,440 00
Present budget of the Lick Observatory	5,500 00

To the above I respectfully recommend the following additions:

Increase of the salaries of Messrs. Tucker and Hussey from $2,000 to $2,400	$800 00
Employment of Professor Aitken as Assistant Astronomer after July 1, 1897	1,200 00
Employment of a Fellow in Astronomy	600 00
Employment of an instrument-maker (who will also take charge of some of the machinist's work, etc.)	1,000 00
Total additions recommended in salaries	$3,600 00
Present salary-roll	20,440 00
Budget apportionment recommended	7,500 00
Total expense of the Lick Observatory, proposed	$31,540 00
Increase, $3,600 (pay), $2,000 (budget); total	5,600 00

The annual expenses of the Harvard College Observatory are about $60,000; of the Greenwich Observatory, $13,100, exclusive of the salaries of 35 astronomers and of 11 workmen; of the Washington Observatory, $68,000, etc.

A comparison of the proposed expenditure of the Lick Observatory with that of the observatories of Harvard College, Greenwich, and Washington will show that even with the increase asked for our budget would only be one half of theirs. If the increase is granted we shall have 9 persons engaged in astronomical work, while Greenwich has 35, Harvard about 50, and Washington at least twice as many as ourselves.

I beg to commend the foregoing summary to your attention. It is based upon an experience of nine years, and its figures are essentially correct. The increase asked for is the least which will enable us to do the work and hold the place which is expected of us. The Lick Observatory is now the best-equipped Observatory in the whole world. We are asking for one half of the income and for one fourth of the staff of our friendly rivals at Harvard, Greenwich, and Washington. I think I can point to the past performance of our astronomers as an earnest of what may be expected of them in the future.

Respectfully submitted.

EDWARD S. HOLDEN.

LIST OF PRESENTS TO THE LIBRARY OF THE LICK OBSERVATORY.

RECEIVED DURING THE YEAR ENDING JUNE 30, 1896.

EDWARD S. HOLDEN, Director.

NOTE.—This list does not, in general, include the names of scientific institutions which regularly exchange their publications for those of the Observatory. For such exchanges see the catalogue of the Observatory Library.

Presented by—	Books.	Pamphlets.	Photographs.
Albrecht, Th.; Branhausberg N. 3, Potsdam, Germany			1
American Book Co.; New York City (1 electro)			
Anguiano, A.; Tacubaya, Mexico			1
Arcidiacono, S.; Observatory, Catania, Sicily		1	
Bredichin, Th.; Sternwarte, Pulkowa, Russia		3	
Bohlin, Karl; Upsala, Sweden			1
Brown, Miss E.; Cirencester, England			1
Ball, Robert S.; Observatory, Cambridge, England			1
Bischoffsheim, R. L.; 3 Rue Taitbout, Paris			1
Bossert, J.; Observatory, Paris			1
Bigelow, F. H; Columbia College, New York City		1	
Brashear, J. A.; Allegheny, Pa.			1
Becker, E.; Observatory, Strassburg in Elsass, Germany			1
Bonté, J. H. C.; Berkeley, Cal.			1
Budd, James H.; Sacramento, Cal.			1
Burckhalter, Chas.; Chabot Observatory, Oakland, Cal.			1
Campbell, W. W.; Mount Hamilton, Cal.		1	1
Charroppin, C. M.; Port Allen, La.			1
Clark, J. M.; The University College, Toronto, Canada		1	
Christie, W. H. M.; Greenwich, London			1
Chandler, S. C.; 16 Craigie Street, Cambridge, Mass.			1
Colton, A. L.; Mount Hamilton, Cal.		1	
Cunningham, T. B.; Canton, China			24
Colberg, Carl Freiherr L. von; K. u. K. Hauptmann a. D., Munich, Germany		1	
Corrigan, S. J.; St. Paul, Minn.		2	
Coniel, J.; National Observatory, Paris		1	
Cruls, L.; Rio Janeiro, Brazil	2		
Downing, A. M. W.; Nautical Almanac Office, Gray's Inn, London		2	1
Dubiago, D.; Observatory, Kasan, Russia			1
Draper, Mrs. A. P.; 271 Madison Aveune, New York City			1
Delmas, D. M.; Mills Building, San Francisco, Cal.			1
Davis, H. S.; Columbia College, New York City		1	1
Dunér, N. C.; Upsala, Sweden			1
Dreyer, J. L. E.; Observatory, Armagh, Ireland		1	
Doberck, W.; Observatory, Hong Kong, China			1
Donner, A.; Observatory, Helsingfors, Russia		2	
Elkin, W. L.; Yale Observatory, New Haven, Conn.			1
Engelhardt, Baron d'; Liebigstrasse 1, Dresden, Germany	1		
Easton, C.; Oldenbarn Straut 87, Rotterdam, Holland			1
Ebert, H.; University, Kiel, Germany			1
Engström, Folke; Observatory, Lund, Sweden			2
Elger, T. G.; Beaumont House, Bedford, England			1
Elvins, A.; 11 St. Vincent Street, Toronto, Canada		2	
Figee, S., and H. Onnen; Batavia, Java		1	
Friend, C. W.; Carson, Nev.			2
Franz, J.; Sternwarte, Königsburg, Germany		1	
Flammarion, C.; Avenue de l'Observatoire 36, Paris	1		
Folie, F.; (Uccle) Brussels, Belgium		15	

List of Presents to Library of the Lick Observatory—Continued.

Presented by—	Books.	Pamphlets.	Photographs.
Fenyi, J.; Observatory, Kalocsa, Hungary	--------	--------	1
Fabry, Louis; Observatory, Marseilles, France	--------	1	1
Fleming, Mrs. M.; Harvard College Observatory, Cambridge, Mass.	--------	--------	1
Frost, E. B.; Dartmouth College, Hanover, N. H.	--------	--------	1
Fergola, Em.; Observatory, Naples, Italy	--------	--------	1
Fritsche, H.; Wassili Ostrow, Kleiner Prospect, Haus, 10, Quartier 20, St. Petersburg, Russia	--------	1	1
Glasenapp, S. de; Imperial Observatory, St. Petersburg, Russia	--------	1	1
Galle, J. G.; K. Sternwarte, Breslau, Germany	--------	--------	1
Gill, David; Royal Observatory, Cape of Good Hope, So. Africa	--------	--------	1
Geelmuyden, H.; Christiania, Norway	--------	--------	1
Guillaume, J.; Observatory, Lyons, France	--------	1	--------
Gould, Miss M. Q.; Kirkland Sreet, Cambridge, Mass.	--------	--------	1
Garavito, Julio; Observatory, Bogota, U. S. of Colombia	--------	1	--------
Gauss, Robert; The Republican, Denver, Colo.	--------	--------	1
Holden, E. S.; Mount Hamilton, Cal. 5 star maps, 6 steel engravings, 1 wood engraving, 2 spectacle lenses, Original drawing of Orion nebula, by Schmidt.	8	61	42
Hasselberg, B.; Academy of Sciences, Stockholm, Sweden	--------	1	1
Hagen, S. J.; J. G., Georgetown College, D. C.	--------	--------	1
Hussey, W. J.; Mount Hamilton, Cal.	--------	1	--------
Harzer, Paul; Sternwarte, Gotha, Germany	--------	--------	1
Harrington, M. W.; State University, Seattle, Wash.	--------	--------	1
Hartwig, E.; Bamberg, Germany	--------	1	--------
Hall, Jr., A.; Ann Arbor, Mich.	--------	--------	1
Hilgard, E. W.; Berkeley, Cal.	--------	--------	1
Holden, Warren; Girard College, Philadelphia, Pa.	--------	5	--------
Houghton, J. F.; 303 California St., San Francisco, Cal.	--------	--------	1
Harkness, Wm.; U. S. Naval Observatory, Washington, D. C.	--------	--------	2
Howe, H. A.; University Park, Colo.	--------	--------	1
Hough, G. W.; Evanston, Ill.	--------	--------	1
Hazen, H. A.; Box 427, Washington, D. C.	--------	--------	1
Hawkins, L. L.; Portland, Or.	--------	--------	1
Hallidie, A. S.; 509 Market Street, San Francisco, Cal.	--------	--------	1
Hébert, E.; 17 Rue Victor-Hugo, Havre, France	--------	1	--------
Keeler, J. E.; Observatory, Allegheny, Pa. (1 lantern slide)	--------	2	1
Kreutz, H.; Observatory, Kiel, Germany	--------	--------	1
Kayser, H.; Bonn, Germany	--------	--------	1
Krueger, A.; Sternwarte, Kiel, Germany	--------	--------	1
Kempf, Paul; Sternwarte, Potsdam, Germany	--------	--------	1
Knobel, E. B.; 3 Tavistock Square, London, W. C.	--------	1	--------
Koya, Saburo; Consulate of Japan, San Francisco, Cal.	--------	4	--------
Langley, S. P.; Smithsonian Institution, Washington, D. C.	--------	--------	1
Lummer, O.; Phys. Technische Reichsanstalt, Charlottenburg bei Berlin, Germany	--------	1	--------
Leavenworth, F. P.; University, Minneapolis, Minn.	--------	--------	1
Lamp, E.; Sternwarte, Kiel, Germany	--------	--------	1
Lindemann, E.; Imperial Observatory, Pulkowa, Russia	--------	--------	1
Luther, R.; Martinsstrasse, 101, Düsseldorf, Germany	--------	--------	1
Lowell, P.; Commonwealth Avenue, Boston, Mass.	--------	--------	1
Leffingwell, A.; 82 Kirkland Street, Cambridge, Mass.	--------	1	--------
Lunt, Joseph; care A. Hilger, 204 Stanhope St., London, N. W.	--------	1	--------
Loewy et Puiseax, MM.; National Observatory, Paris	--------	1	--------
Marth, A.; Markree, Collooney, Ireland	--------	2	--------
Milne, John; care Royal Geographical Society, London	--------	2	--------
Manson, Marsden; Bureau of Highways, Sacramento, Cal.	--------	1	1
Mizzi, Lewis F.; Constantinople, Turkey	--------	--------	1
Mascari, A.; Observatory, Catania, Sicily	--------	3	--------
Michelson, A. A.; University of Chicago, Ill.	--------	--------	1
Marcuse, A.; K. Sternwarte, Berlin, Germany	--------	--------	1
Martin, E. S.; Wilmington, N. C.	--------	--------	1

LIST OF PRESENTS TO LIBRARY OF THE LICK OBSERVATORY—Continued.

Presented by—	Books.	Pamphlets.	Photographs.
Mendenhall, T. C.; Worcester, Mass.			1
Messer, J.; care Carl Ricker, Nevsky Prospect, No. 14, St. Petersburg, Russia			1
McLaren, Lord; Edinburgh, Scotland			2
Montgomery & Co.; 105 Fulton Street, New York City	1		
McAdie, Alexander; Weather Bureau, San Francisco, Cal.		6	
Molera, E. J.; 606 Clay Street, San Francisco, Cal.			1
Mathews, H. E.; 120 Sutter Street, San Francisco, Cal., (Lot of glass negatives.)			
Marye, Geo. T.; 234 Montgomery Street, San Francisco, Cal.			1
Newton, H. A., Yale Observatory, New Haven, Conn.			2
Norton, Mrs. W. A.; New Haven, Conn.			1
Nyrén, M.; Sternwarte, Pulkowa, Russia			1
Newall, H. F.; Observatory, Cambridge, England		1	
Noble, Wm.; Forest Lodge, Maresfield, Sussex, England			1
Nobile, A.; Observatory, Naples, Italy		3	
Oudemans, J. A. C.; Sternwarte, Utrecht, Holland	1		
Oppenheim, H.; Blumeshof 1, Berlin, Germany			1
Olsson, K. G.; Royal Academy of Sciences, Stockholm, Sweden		1	
Oppolzer, Egon von; Vienna, Austria			1
Prince, C. Leeson; Crowboro, Sussex, England		2	1
Parkhurst, J. A.; Marengo, Ill.			2
Perrine, C. D.; Mount Hamilton, Cal.		3	
Peter, B.; K. Sternwarte, Leipzig, Germany			1
Plummer, F. G.; Tacoma, Wash.			17
Poole, A. F.; Stanford University, Cal. (1 circuit breaker.)			
Pickering, W. H.; Harvard College Observatory, Cambridge, Mass.			1
Payne, W. W.; Northfield, Minn.			1
Paul, H. M.; Observatory, Washington, D. C.			1
Poor, C. L.; Johns Hopkins University, Baltimore, Md.			1
Pauli, W.; Mount Hamilton, Cal. (1 lantern slide)			
Peters, Mrs. H.; Mitteltragheim 4, IV, Königsberg, Germany (1 MS. of Bessel's)			
Plum, C. M.; 1301 Market Street, San Francisco, Cal.			1
Prinz, W.; Royal Observatory, Uccle, Brussels, Belgium		1	
Peal, S. E.; Rajmai, Sibsagor, Assam, India		2	
Puga, G. B. Y.; Observatory, Tacubaya, Mexico		1	
Ricco, A.; Observatory, Catania, Sicily		3	1
Rees, J. K.; Columbia College Observatory, New York City			1
Runge, C.; K. Tech. Hochschule, Hanover, Germany			1
Rosén, P. G.; Royal Academy of Sciences, Stockholm, Sweden		2	1
Rajna, M.; Royal Astronomical Observatory, Milan, Italy		1	
Russell, H. C.; Observatory, Sydney, N. S. W.		1	
Rodolph, F. B.; 523 Tenth St., Oakland, Cal. (1,000 lantern mats)			
Rosse, The Earl of; Parsonstown, Ireland		1	
Rowland, H. A.; Johns Hopkins University, Baltimore, Md.			1
Rodgers, Arthur; 309 Montgomery St., San Francisco, Cal.			1
Rijckevorsel, Dr. van; Bataafsch Genootschap, Rotterdam, Holland	1		
Rodin, A.; care of Imperial Academy of Sciences, St. Petersburg, Russia		1	
Swift, Lewis; Echo Mountain, Los Angeles Co., Cal.			6
Schiaparelli, J. V.; Milan, Italy			1
Sadler, Ralph; 25 The Common, Upper Clapton, London, N. E.	1	3	
Searle, G. M.; Catholic Univ. of America, Brookland, D. C.			1
Searle, Arthur; Harvard College Observatory, Cambridge, Mass.			1
Schulhof, L.; Rue Mazarin No. 3, Paris			1
Stockwell, John N.; 1008 Case Avenue, Cleveland, Ohio			1
Sidgreaves, W.; Stonyhurst College Observatory, Lancashire, England		1	
Salazar, L.; Mexico, Mexico			2
Schumacher, R.; Kiel, Germany			1
Shearmen, T. S. H.; Brantford, Canada		1	
Smith, H. L.; Hobart College Observatory, Geneva, N. Y.			1

LIST OF PRESENTS TO LIBRARY OF THE LICK OBSERVATORY—Continued.

Presented by—	Books.	Pamphlets.	Photographs.
Stuyvesant, R.; 16 Exchange Place, New York City	--------	--------	1
Schorr, Richard; Sternwarte, Hamburg, Germany	--------	--------	1
Schott, C. A.; U. S. Coast Survey, Washington, D. C.	--------	--------	2
Schumann, Victor; Mittelstrasse 25, Leipzig, Saxony	--------	--------	1
Sanchez, Alberto; San Salvador, Central America	--------	1	--------
Schuster, A.; Owens College, Manchester, England	--------	--------	1
Schur, W.; Sternwarte, Göttingen, Germany	--------	--------	1
Stone, Ormond; Univ. of Va. P. O., Charlottesville, Va.	--------	--------	1
Spina, S. J., P.; Catholic Observatory, Puebla, Mexico	--------	1	--------
Seeliger, H.; Munich, Germany	--------	--------	1
Schmidt, K. E. F.; Physikalisches Institut, Halle, Saxony	--------	5	--------
St. John, C. M.; U. S. Custom House, San Francisco, Cal.	--------	--------	1
Singleton, M. T.; Rockmart, Ga.	--------	3	--------
Stevenson, Robert; Box 2214, San Francisco, Cal.	--------	1	--------
Stetefeldt, C. A.; 967 Alice Street, Oakland, Cal.	--------	1	--------
Schweiger-Lerchenfeld, Baron v.; Kleine Neugasse 13, Wien V. Austria	--------	1	--------
Taylor, J. M.; Seattle, Wash.	--------	--------	1
Tisserand, F.; National Observatory, Paris	--------	--------	1
Terby, F.; Rue des Bogards, Louvain, Belgium	--------	--------	1
Thaw, A. Blair; Montecito, Santa Barbara Co., Cal.	1	--------	--------
Tebbutt, John: Windsor, New South Wales	--------	7	--------
Valle, F.. Tacubaya, Mexico	--------	--------	1
Vogel, H. C.; Astrophysical Observatory, Potsdam, Germany	--------	--------	1
Warner & Swasey; Cleveland, Ohio, (3 gears for large telescope; 1 brass ring)	--------	--------	--------
Wesley, W. H.; Burlington House, London, W.	--------	--------	1
Wislicenus, W. F.; Emperor William Univ., Strasburg im Elsass, Germany	--------	--------	1
Woodbury, W. E.; 62 E. Eleventh St., New York (12 electros)	--------	--------	--------
Wilde, Henry; Manchester Lit. and Phil. Society, Manchester, England	--------	2	--------
Wiedemann, E.; Erlangen, Germany	--------	--------	1
Wolfer, A.; Sternwarte, Zurich, Switzerland	--------	--------	1
Wolff, F. Theod.; Bonn, Germany	--------	--------	1
Wolf, Max.; Heidelberg, Germany	--------	--------	3
Zenger, C. V.; Smichow, Prague, Bohemia	--------	--------	2
Ziel, F. R.; 410 California St., San Francisco (1 lantern slide)	--------	--------	--------
Adelaide, South Australia; Adelaide Observatory	6	--------	--------
Amsterdam, Holland; Royal Academy of Sciences	--------	7	--------
Austin, Texas; Texas Academy of Sciences	--------	1	--------
Baltimore, Md.; The Trustees of the Peabody Institute	--------	1	--------
Bremen, Germany; Meteorologische Station I—Ordnung Schönhausenstrasse 43	--------	1	--------
Bidston, Birkenhead, England; The Liverpool Observatory	--------	1	--------
Besançon, France; The Observatory	--------	4	--------
Berlin, Germany; Physikalische-technische Reichsanstalt	1	--------	--------
Bonn, Germany; Königliche Sternwarte	--------	1	--------
Brussels, Belgium; Royal Academy of Sciences, Letters, and Fine Arts	13	1	--------
Boston, Mass.; American Academy of Arts and Sciences	1	--------	--------
Budapest, Hungary; Royal Meteorological Observatory	--------	1	--------
Brisbane, Queensland; Queensland Branch Royal Geographical Society of Australasia	--------	1	--------
Berlin, Germany; K. Preus. Akademie der Wissenschaften	1	9	--------
Boston, Mass.; Massachusetts Institute of Technology	--------	2	--------
“ “ Trustees of the Public Library	--------	2	--------
“ “ The Appalachian Mtn. Club, 9 Park St.	--------	3	--------
Berlin, Germany; Gesellschaft Urania (3 electors)	--------	--------	
“ “ K. Astron. Reicheninstitut, Lindenstrasse 91, S.W.	1	--------	--------
Berkeley, Cal.; University of California	--------	2	--------
Brussels, Belgium; Belgian Astronomical Society	--------	1	--------

LIST OF PRESENTS TO LIBRARY OF THE LICK OBSERVATORY—Continued.

Presented by—	Books.	Pamphlets.	Photographs.
Cambridge, Mass.; Harvard University		2	
“ “ Harvard College Observatory	1	7	
Copenhagen, Denmark; Royal Academy of Sciences		3	
“ “ The Observatory		3	
Charkow, Russia; University Observatory		1	
Chapel Hill, N. C.; Elisha Mitchell Scientific Society		1	
Cape of Good Hope, South Africa; Astronomer Royal		1	
Geneva, Switzerland; The Observatory		2	
Göttingen, Germany; K. Sternwarte	1		
Gotha, Germany; Herzol. Sternwarte	1		
Halle a Saale, Germany; K. Leopoldinisch-Carolinische Deutsche Akademie der Naturforscher		3	
Hamburg, Germany; Sternwarte		3	
“ “ Bibliothek der Deutschen Seewarte		1	
Harlem, Holland; Library Musée Teyler		1	
Heidelberg, Germany; Historische-Philosophische Verein		1	
Honolulu, H. I.; Hawaiian Weather Bureau		1	
Kasan, Russia; The Astronomical Observatory		2	
Kis Kartal, Hungary; The Observatory		1	
Leipzig, Saxony; Astronomische Gesellschaft	1		
“ “ K. Sächsische Gesellschaft der Wissenschaften		8	
Lisbon, Portugal; Royal Observatory	1		
London, England; Astronomer Royal, Greenwich	6	1	
“ “ Royal Society	2		
“ “ Royal Astronomical Society	1		
“ “ Nautical Almanac Office, 3 Verulam Buildings, Gray's Inn	1	1	
“ “ British Association for the Advancement of Science, Burlington House, W.	1		
Manila, Philippine Islands; Meteorological Observatory		2	
Munich, Germany; K. B. Akademie der Wissenschaften		4	
Milan, Italy; Reale Osservatorio di Brera		2	
Madison, Wis.; Wisconsin Academy of Sciences, Arts, and Letters	1		
Mexico, Mexico; "Antonio Alzate" Scientific Society		42	
Montsouris, France; Observatoire Municipal		2	
New Haven, Conn.; Yale University		1	
“ “ “ Yale University Observatory		1	
“ “ “ Connecticut Accademy of Sciences		1	
New York City; Columbia College		2	
“ “ “ Columbia College Observatory		1	
Northfield, Minn.; Goodsell Observatory ----(13 lantern slides)			
Odessa, Russia; The Observatory		1	
Oxford, England; Oxford University Observatory		2	
Paris, France; Bureau of Longitudes		1	
“ “ Commission permanente pour l'execution photographique de la carte du ciel		1	
“ “ National Observatory	1	1	
Prague, Austro-Hungary; K. K. Sternwarte		1	
Pulkowa, Russia; Pulkowa Observatory		1	
Portland, Oregon; Oregon Weather Bureau		1	
Philadelphia, Pa.; American Philosophical Society, 104 South Fifth Street		2	
Potsdam, Germany; Astrophysical Observatory	2		
“ “ K. Geodätisches Institut		1	
Puebla, Mexico; The Catholic College		1	
Rome, Italy; Reale Accademia dei Lincei	1		
“ “ Observatory of the Vatican	2	1	1
Rio Janeiro, Brazil; The Observatory		1	
San Francisco, Cal.; California Academy of Sciences	1	5	
“ “ Sierra Club		1	

List of Presents to Library of the Lick Observatory—Continued.

Presented by—	Books.	Pamphlets.	Photographs.
St. Louis, Mo.; The Academy of Sciences	--------	6	--------
“ “ St. Louis University	--------	1	--------
Santa Clara, Cal.; Santa Clara College	--------	1	--------
San Rafael, Cal.; The Selborne School	--------	1	--------
San Fernando, Spain; Marine Observatory	2	2	--------
St. Petersburg, Russia; Central Physical Observatory	4	--------	--------
“ “ “ Imperial Academy of Sciences	--------	4	--------
“ “ “ Russian Astronomical Society	--------	4	--------
“ “ “ K. Akademie der Wissenschaften	--------	1	--------
San Salvador, C. A.; Astronomical and Meteorological Observatory	--------	1	--------
Stockholm, Sweden; Royal Swedish Academy of Sciences	--------	4	--------
Sydney, New South Wales; Sydney Observatory (1 map)	--------	1	--------
Tacubaya, Mexico; The Astronomical Observatory (1 chart)	--------	1	--------
Toronto, Canada; The Canadian Institute	--------	2	--------
Turin, Italy; University Observatory	--------	5	--------
Thorn, Germany; Copernicus-Verein für Wissenschaft und Kunst	--------	2	--------
Tokio, Japan; The Astronomical Observatory	1	--------	--------
Upsala, Sweden; Royal Society of Sciences	1	--------	--------
Vienna, Austria; K. u. K. militär-geographische Institut, VIII, Landesgerichtsstrasse No. 7	--------	3	--------
Washington, D. C.; American Ephemeris and Nautical Almanac	4	1	--------
“ “ The Lighthouse Board, Treasury Department	--------	1	--------
“ “ U. S. Geological Survey	4	12	--------
“ “ U. S. Coast and Geodetic Survey	1	1	--------
“ “ U. S. Civil Service Commission	1	--------	--------
“ “ Smithsonian Institution	--------	6	--------

MONEY GIFTS TO THE LICK OBSERVATORY.

In the last report of the Secretary of the University, a list of gifts of apparatus and money to the Lick Observatory during the years 1888–1895 is given. The present paragraph continues the list to June 1, 1896.

Money, gifts, etc., 1888–1895, previously reported	$39,976 80
Additional cash gifts for the installation of the Crossley Reflector at Mount Hamilton (Contributed by Farmers Union, M. P. O'Connor, G. R. Lukens)	200 00
1895—Sept. 30—Subscriptions to a fund for providing illustrations of Milky Way, Comets, etc., from negatives by Professor Barnard, for a volume of L. O. publications	--------
Oct. 15—Miss H. A. L. Floyd, 5-inch equatorial telescope and mounting	500 00
1896—Jan. 19—Hon. C. F. Crocker, fund to send an expedition to Japan to observe the total solar eclipse of August, 1896—first installment	1,500 00
May ..—Second installment	1,000 00

ADDRESSES IN RELATION TO THE WILMERDING SCHOOL OF INDUSTRIAL ART.

UNIVERSITY OF CALIFORNIA,
BERKELEY, May 20, 1896.

To the Honorable Board of Regents of the University of California:

GENTLEMEN: It is almost impossible to make a mistake in interpreting the wishes of the late Mr. Wilmerding in desiring to create "The Wilmerding School of Industrial Arts," as he plainly said it was "*to teach boys trades, fitting them to make a living with their hands, with little study and plenty of work.*" His purpose evidently was to train *actual individual workers* instead of educated managers or foremen.

To carry out this idea, the instruction must be confined to the limits of those useful and indispensable crafts that require little "book-learning," but plenty of muscle, common sense, and mechanical skill. Such, for instance, as those of the blacksmith, the plumber, the house and ship carpenter, the painter, and the sailmaker.

These and similar trades should be taught, but none of them started unless made thorough and complete. I do not wish to convey the impression that I do not believe in giving them higher education in design, chemistry, mathematics, etc.; or that I do not believe in training boys to be master-mechanics, but I simply say that it was not Mr. Wilmerding's intention to do so; for such men would need plenty of study, but he says "*little study and plenty of work!*" He meant it to be purely a trades school for boys—they can get all the academic training they need in the graded schools.

Such a school will have nothing in common with any other school in the United States—not even the Cooper and Pratt Institutes. They have both boys and girls, and academic studies; while all our manual training and other technical schools are based on their all-round educational quality or value—not their trade or commercial value, and are a different thing entirely. They may be better, but that is not the question! Mr. Wilmerding simply wanted our poor boys to learn common trades.

These trades should be called by their proper names, and each pupil should be kept to the one of his choice, and not be allowed to switch off on to the sidetracks of his fancy, but held for four years on a straight road until the goal is reached.

Each pupil should learn to draw well enough to enable him to lay out his own work, or to sketch what he sees and desires to remember, for herein lies the main difference between a *good mechanic* and a *poor one.*

Good moral character, reasonable intelligence, and a certain age limit, should be required of all applicants for admission, and a certain standard of efficiency should be insisted upon at the end of each year, and before the pupil is allowed to begin the work of the next.

The building should be as plainly and cheaply built as is consistent with use and durability—not more than two stories high—and arranged for the heavy work below and the light work above, with the drawing rooms as far as possible from the machinery. But little machinery and only light power would be needed at first, simply to "rough out" the raw material, unless the trade of machinist were added to those I have suggested.

The location of the school should be San Francisco or Berkeley. The reasons for having it in San Francisco are because it would be nearest to the greatest number of boys, and also nearer its source of supplies. The reasons for locating it in Berkeley are that there are no technical schools on that side of the bay. The pupils would be in a better environment, and removed from the temptations of a large city. They might learn a great deal in visiting the technical departments of the University, and the University students of the engineering departments would learn something from the practical work in construction, sanitary plumbing, etc., carried on at the school.

Your greatest difficulty will be to hold down the management of this school to pure mechanical trades, as originally intended, with "*little study and plenty of work*," for its tendency will be to reach out into more flowery "by-paths," and to climb up into higher realms of theoretical knowledge—like its neighbors—instead of sticking to the practical hard work of the useful trades of the lower grades. It will need holding down!

The superintendent will have the same trouble in holding individuals down to their chosen sphere of work, but if they are allowed to dabble in this, that, and the other, they will never learn to do any one thing well—or be properly qualified to make their way in the world. They should be kept strictly in one path until they are thorough.

Every instructor in such a school should be an earnest, practical mechanic, of wide experience, who can work as well as talk. There are enough superficial talkers among teachers already.

Such a practical trades school as contemplated has a great future before it, for there are thousands of bright boys who cannot apply themselves patiently to the study of books, who, when given something to do with their hands that appeals to their reason, become deeply interested at once, and will work the livelong day with pleasure and profit. To such boys this school will prove a great boon, and will turn into useful citizens many who might otherwise prove a burden to the community.

A trades school would be a good thing to have in every large city—for the poorer classes, who cannot afford to take their boys through the high schools, after passing the graded schools, could place them in these trades schools instead. In this way, the children of the working classes might be learning a trade while others are taking more advanced academic training in the high schools.

At present there is no opportunity for willing boys to thoroughly master a common trade. They are discouraged by "trades unions," and we have to depend largely upon foreign labor in all mechanical pursuits.

Such a school will help to generate healthy ideas in those boys who seem to think that mechanical work is humiliating, and below their dignity—even though their fathers followed it—as they are now educated side by side with the rich and in the same way without the slightest allowance being made for the great difference in their social prospects or future environment. They learn to look down on honest labor, and prefer earning $10 per week as clerks rather than $3 per day as mechanics.

I think that Mr. Wilmerding must have felt that our future prosperity depended quite as much upon trained hands and eyes as upon trained minds, and that the chief faculty cultivated in his time was that of remembering words only—and being in sympathy with the dignity of labor and the needs of the State, he felt that he could do the greatest good to the greatest number at the least expense by this generous gift, which will doubtless prove an unlimited blessing.

HENRY T. ARDLEY.

UNIVERSITY OF CALIFORNIA,
BERKELEY, June 4, 1896.

To the Honorable Board of Regents of the University of California:

GENTLEMEN: The conditions that should surround and, in a measure, affect the location of such a school as that provided for by the bequest of Mr. Wilmerding, separate themselves into two classes, which I may characterize as general and special.

The *general conditions* are those born of the fact that the Wilmerding is to be a State trades school, one of the schools of the University, in which boys shall, "through little study and plenty of work," make of themselves self-respecting, self-supporting men, and safe citizens of our great State. These are five in number, and so eminently important, that they need but to be stated:

First—The school should be so centrally located as to be easy of access from all parts of the State. This centrality should be determined not alone on the geographic score, but should take into account the established lines of travel as well.

Second—The immediate neighborhood of the school should afford homes of physical and moral healthfulness. This point is even more important in the case of the Wilmerding than in that of the University proper, for the reason that the boys attending this school will be from four to five years younger than the body of the undergraduate students at Berkeley.

Third—The school should have large and varied manufacturing enterprises within easy access. These are to a trades school what the courts and the hospitals are to the schools of law and medicine.

Fourth—Proximity of primary markets is an important item in securing cheap fuel and raw materials, as well as in disposing of the product of the shops. In this connection let me remark that it is, in my judgment, highly important to the success of such a school that its output shall stand the practical test of the market.

Fifth—Other things being equal, this school ought to be within a few hours' travel of the University, for three reasons, viz.: (*a*) Visitation and counsel from the President and heads of some of the related departments of the University will be of great advantage to the school; (*b*) Knowledge of the conditions obtaining in a first-class trades school, easy of access, would be of high value to many departments of the University, notably the departments of education, economics, sociology, etc.; (*c*) Such location would contribute to the ease of administration by the Board of Regents.

The *special conditions* I have in mind would vary with the trades taught, the length of course, and other matters not at present determined. I shall, accordingly, dismiss these with a few considerations suggested by the discussions of the last twenty-four hours.

First—The mission of the Wilmerding should be formatory and not reformatory. There are enough good boys, anxious and worthy of such training, who will make strong citizens and efficient tradesmen, and who should not be set aside by those who are on the downward track morally. The work of such a school should be preventive, rather than remedial. You cannot mix, to any large degree, healthful formative and reformatory work. If you undertake the latter, you not only interfere with the mission of two State institutions already established, but you will be compelled to give up the true preventive and constructive work.

Second—This should be a permanent effort to make labor and the laborer more dignified and intelligent. To do this the home of the movement should be neither cheap nor uninviting. Plain, but durable buildings, especially adapted to the work to be done, should be the home of the school. We must bear in mind that the tradesman is more than his calling, and that the only justification for this work is the development of better citizens.

Third—Great care should be exercised in determining what trades to teach. This is in many senses an original problem not to be solved entirely by any previous experience. The conditions economic, educational, and sociological, all need to be carefully studied. Whatever conclusion is reached, I beg to suggest the wisdom of making the first part of every boy's course general, for the reason that it will help him to choose more wisely from the trades subsequently offered. It will also give him mechanical versatility, which is a necessary equipment of the successful artisan in this day, when inventions are transforming some trades and destroying others.

Fourth—I venture to suggest that this school should not undertake the production of *moderately-good* workmen. It should aim to turn out *first-class* tradesmen. To this end it should not hope to do in a year or two what has in the past required six or seven years of faithful apprenticeship. While the trades school should do more and better work in less time than the apprenticeship system, thorough training requires adequate time for growth and assimilation.

Fifth—While such a school should keep clearly in mind the limitations of the gift which brings it into being, it should also be borne in mind that you are to build for the future, that other benefactions will be added to that of Mr. Wilmerding, and that the State of California will stand behind wise administration of this charge. No money ought to be invested in temporary makeshifts.

Respectfully submitted by

CHARLES H. KEYES,
President Throop Polytechnic Institute.

PASADENA, CAL., June 1, 1896.

UNIVERSITY OF CALIFORNIA,
BERKELEY, June 3, 1896.

To the Honorable Board of Regents of the University of California:

GENTLEMEN: In response to request contained in letter of Secretary of your honorable body, I submit herewith my views with regard to the "Wilmerding School of Industrial Arts."

The terms: Manual Training, Industrial, Mechanic Arts, and others, ordinarily applied to schools of an industrial character, should be clearly defined and fully understood at the beginning of the discussion. The definitions of these terms, the purposes of the school to which they apply, and the distinctions between trade and educational schools were so clearly drawn by the various speakers at your meeting on the 19th ult., that I would call attention to but one point, which, it seems to me, is a pivotal one. Granting that a trades school is not an educational institution, that its aim is to cultivate a muscular rather than a thinking habit, it should be borne in mind that trades schools are themselves of two kinds—the first preceding an academic or manual-training education; the second, the trades school, in which, after the student has devoted two or three years to high school studies and shop-work, he specializes, devoting his entire time to the mastery of some one trade. As types of this latter class there are the Throop School at Pasadena, the Lick School of Mechanic Arts in San Francisco, the Drexel Institute at Philadelphia, and many others.

There can be but little doubt in the minds of those who listened to the testimony presented by the intimate friends of Mr. Wilmerding at your meeting of May 19th, that he had in mind the trades school of the first class, in which boys of the street, apparently destined to criminal careers, could be brought under healthful influences and trained in one or more useful occupations. In his will, Mr. Wilmerding recommends the establishment of an institution in which plenty of work can be found for the boy's hands, and little for his head. This recommendation, taken in connection with the testimony of his friends, is open to but one interpretation, that it was his intention to assist poor and homeless boys to become skilled artisans and respectable citizens. The establishment of a trades school of the second class, in which young men learning a trade might apply the principles of a comparatively advanced high school training, was evidently as remote from Mr. Wilmerding's aims as the establishment of a law or other professional school could be.

In establishing a trades school of the first class—such as was outlined by Mr. Schussler—it would be necessary that the school administration be vested with full parental authority over the pupils. Boys of the age at which Mr. Wilmerding had in mind are, many of them, on the streets because their parents cannot keep them at school. They tire of the monotony of school-life, and rebel against its discipline. The novelty of an institution, in which mechanical reiteration is a prime factor in the plan of the school, would soon grow tiresome, and unless attendance at school work were made compulsory and legal measures adopted to enforce it, the boy would soon find his way back to his old haunts.

In trades schools, in which boys are admitted at the early age of twelve or fourteen, two methods have been in use for the purpose of insuring continuous attendance until the boy is prepared to work independently at his trade. The first is that of paying him a small daily stipend. At some schools, in which boys are taught harness-making, plumbing, painting, printing, etc., the pay is, for the first year, eight cents a day; for the second, fifteen cents, and so on—the articles manufactured by the boys bringing in the needed funds. The second may be termed the dormitory method, and is in force in Williamson, Pa. In such a school the pupils are housed and fed at the school.

In view of the fact that this city is amply equipped at present with manual training schools and with manual training and trades schools combined, and because there is no institution at present in existence in California which provides instruction for our city waifs, in the line suggested by Mr. Wilmerding, I would recommend the establishment of an institution that combined both types: that is, one in which the boys were paid small daily wages, a part of the necessary income being derived from the sale of manufactured articles, and in which pupils were boarded at the school and indentured to the trustees for two or three years. Our Legislature could readily provide the Acts necessary to meet the requirements of organization.

In the Whittier Reform School the trades are taught, but the school, like our prisons, is a penal institution; boys are sent there as a punishment for misdeeds. In the school I recommend, not only should the idea of punishment as a motive for enrolling a boy in the school be carefully avoided, but admission to the school should be considered desirable and honorable. While the nature of its organization, in that its board of control should be vested with parental and police powers, is similar to that of a reform school, yet it is not a reform school in the sense that it attempts to reform boys of hardened characters, or that admission thereto is a stigma upon the character of its pupils. Withdrawal from the school should lie, not within the discretion of the boy, but of his parents, and even then for reasons that are satisfactory to the school authorities.

Such a school, if wisely and economically administered, is not only feasible and in conformity with the wishes of Mr. Wilmerding, but would meet the wants of a worthy class in our community, for which at present neither public nor private funds have made any provision.

Location.—This school should not, in my opinion, be located within the confines of a large city. If it were, it would be necessary to build about it a high wall. In the country, on the other hand, the influence of country life is healthful. Land is cheaper, more land is available for playgrounds, and a larger area could be devoted to school use than could be had in a large city. The school should not be so remote from a large city as to make the transportation of boys a matter of serious expense, nor should it be near enough to make it easy for the boys to return to their former associations.

Teachers.—As to teachers in this institution it is of the first importance that they should be skilled artisans; not men of academic education, but masters of their particular trade. If these artisans are men of education, their ideals will influence their policy. Before the school has been long in existence we should find that less time was given to the hands and more to the head; that the school, through the conscious or unconscious efforts of its instructors, was drifting toward the second or manual training class, and away from its original plan of usefulness to poor boys. It would be the natural ambition of educated artisan instructors to enroll in their classes, not the young boys of the street, but those who may already be provided for in our manual training, public, or private high schools. To keep the school within the lines Mr. Wilmerding has suggested, I should say that the school must be absolutely divorced from the influences of a manual training school.

Our city is at present richly equipped with facilities for manual training. The Lick School of Mechanic Arts, the Cogswell Institute, and the Polytechnic High School are all working in practically parallel lines, their academic courses being nearly identical. The trades course, which is a feature of the Lick School, and follows the course in manual training, is wanting in the other two institutions.

The pupils attending these manual training high schools are not, as a rule, pupils who have spent their tender years on the street. They are not of the class Mr. Wilmerding intended to assist.

I would say, in closing, if it is the intention of your honorable body to establish a manual training school, that in view of the ample provision already made in our own city for these schools, the interests of the State would be best served if the school were located in some central city in which manual training facilities at present are lacking; if in San Francisco, that it be combined with some manual training school already in existence.

Yours respectfully,

WALTER N. BUSH.

Polytechnic High School,
San Francisco, Cal., June 1, 1896.

University of California,
Berkeley, May 27, 1896.

To the Honorable Board of Regents of the University of California:

Gentlemen: I herewith present a statement concerning the disposal of the bequest of $400,000 of the late J. Clute Wilmerding, for the establishment of a trades school for boys, to be called the "Wilmerding School of Industrial Arts," fitting them to make a living with their hands, with little study and plenty of work. I do not know what the nature of the report is you desire, but I shall give you a report showing what may be done with the above-mentioned bequest. I give you a dollars and cents report, for that is what the bequest consists of.

Let us suppose that we have a site selected and the property—that is, the land upon which the school is to be built—donated, which seems to be probable, since many offers have been made.

The first cost of the construction of the buildings, equipment, etc., will now be considered. I have given this portion of the subject particular attention, and have had a varied experience in the construction and equipment of several manual training schools; among them the shops of the Leland Stanford Jr. University and the California School of Mechanical Arts, besides several others for which I have been called upon for advice in the equipment and general construction. I state this not to be egotistical, but to show you that my statements are facts, not theories, and founded on experience.

I have in my possession ideal plans of shops, of my own design, consisting of a machine shop, a foundry, a blacksmith shop, and a wood-working shop; engine and boiler room and all necessary toilet rooms. Also, the plans of the shops and the academic building, with rooms more than sufficient for a school of the kind required for a trades school, the plans of the California School of Mechanical Arts, furnished me by the architects, Percy & Hamilton.

The cost of these two buildings, including the building of retaining walls, extra cement foundation, and other accessories not necessary for a boys' school, was $45,000. Messrs. Percy & Hamilton also advise me that the same could be built to-day at even a less cost. Subtracting from this an amount of $5,000, which, in my judgment, may be easily saved by economical construction, I place the cost of the two buildings, equal to any in the country for convenience and durability, at $40,000, complete and ready for equipment.

The equipment of the shops I shall enumerate individually, with their necessary tools, machines, and cost of same. The engine and boiler will be first considered. I would advise an automatic, high-speed, non-condensing engine; non-condensing for the reason that the exhaust steam may be utilized for heating purposes, which is good economy when properly used. Automatic high-speed, because it is modern and best adapted for electrical purposes, which I hope will be a special feature of the school.

The boiler should be a water-tube boiler, of the Babcock, Heine, or Sterling type, because they are modern, safer, and I believe (though not certain) a little more efficient than the ordinary tubular boiler.

The cost of an engine, 9 inches in diameter of cylinder, with 10-inch stroke, initial pressure of steam at 80 lbs., running at 300 revolutions per minute, and cutting off at $\frac{1}{4}$ stroke—the most economical point of cut-off, or rather the point of cut-off that engines are generally rated at—will cost about $650 for the best in the market. The boiler (50 horse-power), feed-pumps, pipes, valves, fittings, including a separator for dry steam, will cost $2,000.

The equipment of the wood shop will include the following: The cost of a wood shop, equipped complete with 26 benches, 15 lathes, combination circular and rip saw, band saw, planer, jig saw, shafting hangers, belting, and 30 sets of tools for benches and lathes, will cost about $3,500.

The blacksmith shop, equipped with 26 forges, exhaust and blast pipes and fans, benches, tools, and small steam hammer, will cost about $2,000.

The machine shop is the most expensive one; its equipment will amount to about $7,500 for an ordinary equipment.

The foundry may be equipped for $2,500. The engine and boiler, pumps, and furnace, erected for use, about $2,600; dynamos, $500.

Allowing $5,000 for the equipment of laboratories and rooms in academic building, which is a liberal allowance, will make the total equipment cost $23,600. Adding $41,400 for the building and heating plant, will make the total cost $65,000 for the two buildings, built and equipped ready for use. $400,000 minus $65,000, equals $335,000: this is the amount left to maintain the school. This amount, well invested, should realize 5% on the principal, or $16,750 per annum. All of these figures are based on actual computations of shops already constructed, not estimates or probabilities.

Allowing the maximum number of pupils to be 250 in the school, which is a goodly number for a school of that kind, and allowing 25 pupils to an instructor, will make ten instructors; one principal, who should also assist in instructing; one engineer, and janitor.

The instructors may be as follows: One each in mathematics, science, English, mechanical drawing, free-hand drawing and modeling (one for both), blacksmith, wood-working, machinist, shop practice and foundry work, with salaries at $1,200 per annum each, equals $10,800; an engineer at $1,000, janitor work at $900, and a principal at $2.200. This will make in all $14,900 for salaries, leaving a balance of $1,850 for a sinking fund for renewals, repairs, etc., which should be few in such a school, where everything should and can be made, from the finest instruments to the building itself. These are not princely salaries, but school teachers are philanthropists and care only to exist.

I think the student should be charged a fee large enough to cover the expense of the material used, also the gas, fuel, etc., used in the institution. This should not amount to more than $12 to $15 per year for each student. When the school has advanced to a condition to manufacture marketable articles, these fees may be avoided and probably an income above expense received for their work.

I presume, also, that this school is exempt from taxation, or should be, having been donated to the State, and managed by the Board of Regents of the University of California. This will allow a balance of $1,850, enough for all sundry expenses for any school of the size and kind specified.

Gentlemen, I believe this portion of my report correct and feasible. I have been liberal in my allowance for equipment, if small on salaries.

The adoption of a course of study will now be considered, and I shall give you my individual opinion, which I hope will only be received as such. The academic work should consist of English, science, and mathematics. I class mechanical drawing, free-hand drawing, modeling, and carving (stone and wood) as manual.

A great many people look upon a trades school as a place where students should be taught only the mechanical methods of trade, just as in the commercial shop; in fact, their idea is to teach the boy only how to pound iron and saw wood. This fallacy, gentlemen, I hope you will not fall into. The policy of a school should be to train the young men in useful arts, whereby they may make a living with their minds and hands. I say minds and hands, for I think that a school that would teach the boy only the mechanical application of a trade, and not give him the foundation on which he may build his ambitious desires, is not a nineteenth-century school. A mechanic that can only pound iron or saw wood and say or think nothing more, is only a machine.

The ambitious mechanic of to-day in the shops is trying to raise his standard; he applies to our night schools for mental instruction, and from him comes our best labor. Shall we then, as educators, lower his standard? I think not. The mechanic has been the useful element of society; through him come the necessities, the comforts, and the luxuries of the world, yet how ungrateful has the world been to him. Since history began he has been a slave; all the great engineering work done by the ancients was done under the yoke of serfdom. The shop man is still a slave—a slave to circumstances and ignorance, and I believe narrower to-day than in the days of our fathers, because of the specializing of operations, the greed of the large shop-owner, and the creation of monopoly. What is the cure? Education; a broad education, coupled with a knowledge of skillful mechanical manipulation, and with this comes a proper appreciation of one's self—a manly self-esteem. Therefore, let our boys graduate as skilled mechanics in some chosen branch, with a knowledge that will make them also men of society, upright citizens, patriots.

The question is often asked, Can a boy learn a trade at school? Is the scope great enough? Yes, he can, with proper equipment and instruction.

I answer this boldly, for I have passed through every stage of the practical mechanic, from the poor apprentice at $2 per week to the superintendent of a large machine shop at too low a salary. I have also seen the college side of manual training or mechanical training, having spent four years as a student with Professor Woodward, the father and promoter of manual training in this country. (I state this to substantiate my assertions, not to intrude personalities.) But the scope is so small, is the objection offered. True, we cannot build city hall domes and cruisers in our schools, but we can build principles and mental foundations upon which these domes and cruisers rest.

If a person learns that 4 times 10 equals 40, need he learn another principle that 4 times 100 equals 400, or 40 times 100 equals 4,000? If a boy learns how to run and manipulate a 12-inch lathe understandingly in a school shop, can he not run a 16-inch lathe in an employer's shop? When a man knows 4 times 10 equals 40, he knows it as well as the greatest arithmetician, regardless of where he learned it, whether at Yale or Wilmerding School. So it is with a trade.

We should teach them more than a trade; we should teach them English, so that they may read and express themselves intelligently; we should teach them history and civil government, so that they may become intelligent citizens, and appreciate the grandeur of our country and the value of liberty; we should teach them mathematics, the acme of analytical reasoning and the foundation of all mechanical construction; free-hand drawing and modeling, the art of silent expression; mechanical drawing, the universal language of the mechanic; physics and chemistry, or the laws of nature's God; applied mechanics; and surveying:—then, when our student has finished his apprenticeship at our school, he will be a tradesman, not a trades-machine.

The English may be confined to rhetoric, word analysis, proper construction of sentences, with lectures on some of our classic writers.

Mathematics will consist of arithmetic, algebra, geometry, and trigonometry; all of these are necessary, not only useful, to the ordinary machine designer.

Mechanical drawing should embrace constructive geometry, a simplified course of descriptive geometry, which, of course, includes orthographic projection, the basis of all mechanical drawing.

The practical portion of descriptive geometry should be thoroughly dealt with in a practical way, showing its use in carpentry, such as the proper manner of obtaining the angles or "cuts" for the rafters in a hip roof; the cuts for the intersections of cornices, both metal and wood; sheet-iron work of all kinds; tin, copper, iron, and in fact in every branch of the mechanical trades, this useful applied science may be used with good results, in machine and architectural design.

The branches of mathematics advised are too evidently useful to need any explanation for the introduction of them, except possibly trigonometry, a long name for a simple science; this is the arithmetic of geometry, and more often used in mechanical constructions than geometry, but of course a simple knowledge of the latter must precede the former. Why speak of a tangent galvanometer, sine curved, law of sines, etc., and know them only by name, without reason? This study is also necessary for surveying, a branch that should be taught.

Free-hand drawing and modeling should be taught not only as an education for the eye and hand, but as a most useful branch of industrial operations. Free-hand drawing is necessary in architectural designs, in designing of iron-work for all purposes, artistic and mechanical; in fact, no mechanic or draughtsman is complete without being able to express himself by free-hand drawing.

Modeling is an art when you consider the model of the sculptor only, but when you consider its use, yes, necessity, to the stonecutter, to the interior decorator, to the designer for industrial art purposes, such as potteries, bronze, and iron castings and hammered work for gates, massive doors, and branches too numerous to mention, then it is an industrial branch.

Physics should mean applied physics, principally mechanics, including statics, dynamics, the laws of machines, hydraulics, heat in its relation to the steam-engine, etc. These branches should be taught by laboratory methods when possible.

Electricity, including the phenomena and theory, electrical measurements of all kinds, and the construction of measuring apparatus and machines, as actual construction by the student clears the mystery that usually surrounds these instruments of measurement and gives the student a wider scope and more reason in the use of them.

I would advise particular attention to be paid to the graphical processes of obtaining results in all our work, such as the graphical methods of force and motion, diagrams in roofs and trusses, graphical construction in valve diagrams for the steam-engine, etc.

These methods are simpler than the analytic, usually, and serve as a map to the entire proceeding in each portion of it, step by step, and, being a mechanical process, more in accordance with the idea of the school. In fact, the course of physics should be a simplified course of engineering, with lectures and experiments on such subjects as optics, sound, etc., given by the instructor, but not dealt with so thoroughly as the more practical branches enumerated.

Chemistry may be limited to inorganic, with an idea of analysis of minerals and a treatise on practical assaying.

The trades or occupations as a means of livelihood may now be considered. Wood-working may include joinery and carpentry, cabinet-making, pattern-making, and carving, supplemented by wood-turning in all.

Metal-working trades may include machine-shop practice, lathe, planer, in fact all work done on or by machines, bench or vise work, and construction work.

Blacksmithing for the machine-shop, wagon and ornamental work.

Foundry work, including brass and iron founding in all its branches, with lectures and experiments on cupola practice and construction; the elements of metallurgy, with practical instruction on the best mixtures of metal for specified purposes.

Stone-cutting and wood-carving, for buildings, ornaments, and sculpture work.

The practical electrician course may be introduced in a school with great profit and not much outlay. This course, or occupation rather, will consist of wiring of buildings for electrical purposes of all kinds, such as bells, lighting, telephone, etc., the winding and construction of machines, dynamos, and all electrical machines, electro-plating and practical operations, without the dense mathematical theory and formulæ used in their design or the engineering proper—for this is a higher grade of work.

Of the semi-professional occupations, we may include the draughtsman, architectural and machine; also, the designer for ornamental work, etc.

The time required to complete a course in the school should be four years. I should advise spending the first year at principles of shop-work in the various branches, devoting a certain number of hours to each, each day, with their academic work; after having spent one year at miscellaneous work, and having found the pupil's adaptability, also desires, he must then choose a special branch of mechanical work as a specialty or trade, and devote a greater portion of his time to such trade, coupled with such studies academic as may promote his welfare in his choice. If he take pattern-making, for example, let him also study mechanical drawing and machine design and mathematics throughout his course.

The following time schedule may be considered :

	Periods per Week.						Total Hours per Week.
	History and English.	Math.	Science.	Mech. Drawing.	Free-hand Drawing.	Shop.	
First year	5	5	5	5	5	12	35
Second year	2	5	5	5	5	20	40
Third year	0	5	5	5	0	27	41
Fourth year	0	2½	2½	2½	0	34½	42
						93.5	158
Total average number of hours per week						23.37	39.5

158 divided by 4 equals 39.5, equals the total average number of hours per week devoted by each student to the school during four years. 93.5 divided by 4 equals the total average devoted to shop work, equals 23.375 hours per week, or about 60% of the total time. I should think this little study and much work—comparatively as little study as will make the boy the best mechanic and fit him to be a good citizen and a man capable of reaching the highest mark of mechanical ability. These are the number of hours devoted entirely to work at the special trade chosen by the boy, excluding mechanical drawing, etc., and manual exercises. I believe our mechanics should be educated in mind as well as in handicraft.

I know with such a schedule a man may become an expert workman, also an accomplished draughtsman, and mathematician enough for ordinary practical purpose in the time allotted. The question is asked, Why does not the boy do equally well or learn as much in as little time in the commercial shop? I again answer, from personal experience, that too much time is wasted in drudgery labor work in the commercial shop, that the student should not be expected to do; I believe a certain amount is necessary and just, but a boy, be it in the school or shop, should not be a slave for the journeyman, or to the greed of the employer; this is too often the case.

Yet another point in the shop of commerce: An apprentice usually learns by observation; he is not given a systematic course of training under a presumably conscientious, intelligent instructor, but put where he fits best to his employer's financial profit, too often regardless of the boy's welfare.

This is not the case in the school. Here he is instructed carefully in the best practical methods, his mistakes corrected for the sake of instruction only. The student fears not the condemnation or dollars-and-cents wrath of his employer if he make mistakes, and he will do so often. A boy should, however, be carefully judged and penalties imposed for neglect or carelessness of duty, and I believe the average boy is as proud of his reputation and its merits and credits as a student as he is of his employer's dollars.

If a student show no adaptability for a mechanical occupation or trade after a year's trial, he and his parents should be informed, and allowed to seek his proper plane. A poor mechanic is not quite so destructive as a poor physician, nor so ridiculous as a poor writer, but quite as lamentable and more evident; for, in the first, if the patient revives, he receives the glory; if the patient dies, it is Providential. The mechanic's work is all his own, good or bad, a living monument to his ability; therefore, make good mechanics by proper selections.

The question may be asked, Why are these four branches usually chosen? Why not substitute masonry, plumbing, shoemaking, etc.?

The four branches enumerated are the ones of widest scope. They allow the student more opportunity for development; for instance, when a boy is a skilled mechanic at pattern-making or joinery, he is capable of doing all kinds of wood-work, from ornamental turning and finishing to the construction of wooden bridges and roofs.

The special demands of the location of the school, if they are not petty, or applicable only to this locality, may, however, guide somewhat in the selection of occupations.

The machinist means the engine-builder, the electrical constructor, the brass-worker, the maker of mathematical instruments, and branches too numerous to mention. All are closely allied and require only a limited practical knowledge of each specialty to enter into any, as the foundation is machine-shop practice.

Foundry and blacksmithing and pattern-making are close relations to machine-shop practice, and the combination makes a man a strong, desirable mechanic, a superintendent as well as a laborer or constructor.

Plumbing is an important trade, but not so broad as the others.

Masonry is also a most important branch, but difficult to teach, because of the necessary magnitude of the practical construction itself unless we modify it to play-houses and small portions of structures, and this is unsatisfactory; yet, stone cutting, dressing, and setting could be taught.

Such trades as shoemaking are not included in the scope of the skilled manual mechanic. They are products of the machine entirely; hence, not practical for educational purposes.

I state these comparisons to give some reasons for the selection of trades or occupations.

The selection of instructors in a school of this kind is of paramount importance. The principal, or better, the superintendent, should be an expert mechanic, and a learned man besides. He should be a man of good academic training, and, if possible, one accustomed to the management of men and schools.

It is difficult to find one man with all requirements, at the salary the ordinary school can afford, for I believe a man must have an education broader and more versatile than the average college professor who specializes and has only one or two branches to look after.

His judgment must be of the best, for trade-school work is not theory, but substance—tangible articles that speak for themselves. His policy and management, his knowledge of things practical, modern, and efficient, will be critically judged by the public, and the mechanical public at that. They judge justly, generally, though harshly.

Employ, then, a superintendent who has worked himself, who knows and can feel the mechanic's position, who also knows and appreciates the value of education and the skilled mechanic.

For the assistants, shop and academic, obtain if you can people of technical school education, with practical mechanical training elsewhere as shop hands; but do not think that an ordinary hewer of wood or shaper of metals, whether he uses proper language or whether he knows anything but his trade, is a proper man to fill such a place; for boys respect an educated man, and the educated man is the better teacher, generally more progressive; in all, he is an educator, therefore should be educated.

The age of the student should not be less than fourteen years, and he should have at least an eighth grade grammar school education. Younger than this he is physically undeveloped to enter upon a trade, and mentally unfit to grasp the studies required of him, such as mechanical drawing, geometry, physics, etc.

I have heard this expression from men, generally not mechanics: "Place the school down among the shops and manufacturing districts, so as to be near the factories." I think this is a mistake. Place the school in a healthy, fine location, in the midst of a populated district, easily accessible to the greatest number of working people; in a district not already supplied with such a school.

When the Wilmerding School project was first brought to my notice, I laid the matter before several members of our board and urged them to bid for it to unite with Cogswell. This was an ambitious, selfish move. I admit that a combined school would enhance the reputation and work of that one school, probably be able to pay its teachers and principal larger salaries, but is it the best for the public good? Is it not better to have smaller schools like the Lick, the Polytechnic, and the Cogswell, that can care for the people in their districts, and have them distributed so they may be easily reached by the pupils of the various localities without carfare, if possible, than one grand building half-filled because "it is too far to go and we cannot afford the carfare"?

This at once places before us the vexed question of site. Where shall the Wilmerding School be located? What section needs it most? Are our schools here sufficient to supply our demands? Do they take care of our children? Do they teach trades? How many children graduate from the eighth and ninth grades of the grammar schools each year that are fit and desire to enter a trades school?

Are our technical schools crowded now? How many can each accommodate, and how many graduate each year? If we have schools enough here in San Francisco of that kind, are we benevolent and unselfish enough to see it go elsewhere, provided it is offered us, and if it goes, is there a town or city in California with population enough to demand such a school not already supplied?

These questions, gentlemen, you can answer better than I, if I thought it proper to answer or even to suggest a locality. I hope this report will be considered only as an individual opinion; therefore, I shall make no apology for my assertions and for what may appear to be presumptuous.

L. A. BUCHANAN,
Principal of Cogswell Polytechnic College, San Francisco.

DISBURSEMENTS FOR THE YEAR ENDING JUNE 30, 1896.

APPENDIX No. 1—*Salaries.*

Administration	$29,426 35
Agricultural Experiment Stations	6,005 04
Forestry Stations	1,200 00
College of Agriculture	11,358 99
College of Chemistry	15,261 29
College of Civil Engineering	12,993 32
College of Letters	25,687 72
College of Natural Sciences	13,429 06
College of Social Sciences	23,908 81
College of Mechanics	15,636 91
College of Mines	9,594 35
Department of Lick Observatory	20,386 25
Department of Physical Culture	3,229 67
Department of Latin	77 50
Library	4,380 00
Museum	1,050 29
University Printing Office	1,560 00
Viticulture	649 98
Morrill Fund	21,000 00
	$216,835 53

APPENDIX No. 2 A—*Administration—Fuel.*

136 tons, 2140 lbs. Wellington coal—J. P. Taylor & Co.	$1,224 29
15 tons Welch Anthracite coal—J. P. Taylor & Co.	164 85
Weighing above coal—L. N. Hagar	6 00
5 tons patent coke—J. P. Taylor & Co.	61 25
	$1,456 39

APPENDIX No. 2 B—*Administration—Equipment.*

10 rolls toilet paper—John Maison	$0 50
14 lantern slides—Andrews & Lange	7 00
Labor, month of June	57 50
1 reversible blackboard—C. F. Weber & Co.	16 20
Labor, month of July	32 50
Lathing and plastering—Whitney & Mara	40 00
30 pieces corrugated rubber matting—Bowers Rubber Co.	39 75
1½ doz. perforated seat chairs—California Furniture Manfg. Co.	12 35
2,811 cu. ft. gas—Oakland Gas L. & H. Co.	6 55
Labor, month of August	25 20
1 porcelain-lined sink—W. F. Wilson	9 45
1 bronze gas pendant, 2-light—Thos. Day & Co.	1 75
1 drop-light—Thos. Day & Co.	3 00
100 ft. base board—Johnson & Cavan	3 00
100 ft. base molding—Johnson & Cavan	2 50
100 ft. base shoe—Johnson & Cavan	1 00
40 ft. 6″ sewer pipe—Barker & Hunter Co.	4 20
6 6″ long tees—Barker & Hunter Co.	2 52
4 6″ ⅛ bends—Barker & Hunter Co.	1 40
58 tablet chairs—G. H. Fuller Desk Co.	135 72
1 6-tray cabinet, with outfit—Library Bureau	22 00
250 lbs. Pioneer lead—W. P. Fuller & Co.	15 00
1 doz. floor brushes—Levenson & Co.	27 00
1 doz. turkey dusters—Levenson & Co.	3 50
1 doz. sponges—Levenson & Co.	4 50
1 doz. papers tacks—Levenson & Co.	25
2 gross matches—Levenson & Co.	1 20
2 doz. brooms—L. Feldmann & Co.	6 00
1½ doz. hand brushes—L. Feldmann & Co.	8 25
1 doz. whisk brooms—L. Feldmann & Co.	1 50
1½ doz. chamois skins—L. Feldmann & Co.	6 75

Administration—Equipment—Continued.

1	doz. hand scrub brushes—L. Feldmann & Co.		$1 50
57,560	cu. ft. gas—Oakland Gas L. & H. Co.		12 85
	Labor, month of August		27 00
2	doz. Sterling erasers—Le Count Bros.		3 20
16	sacks sawdust—G. C. Pape		4 00
25	lbs. Castile soap—Lake & Co.		2 00
6	hand hatchets—Lake & Co.		2 25
1	box sand soap—Lake & Co.		1 20
3	doz. papers 4 and 6 oz. tacks—Lake & Co.		90
1	can matches—Lake & Co.		85
68	tablet chairs—G. H. Fuller Desk Co.		159 12
330	yds. cocoa matting—W. and J. Sloane & Co.		181 50
	Labor, month of September		24 00
600	lbs. Prince's metallic paint—Yates & Co.	$9 00	
154	gals. raw linseed oil—Yates & Co.	77 00	
		$86 00	
	Less 2%	1 72	
			84 28
12,000	cu. ft. gas—Oakland Gas L. & H. Co.		24 00
7,600	cu. ft. gas—Oakland Gas L. & H. Co.		17 10
	Labor, month of October		27 00
	Repairing plastering—Whitney & Mara		9 00
1	door and casing and fittings—Johnson & Cavan		18 00
6	McGriff fire-extinguishers and reporters—G. H. Tay Co.		66 00
12	3″ tubes for heater, and labor—T. N. Noble		25 00
	Labor, month of November		26 00
48	pkgs. chloride lime—John Taylor & Co.		5 00
3	bdls. twine—Schmitt & Zehner		40
100	copies of Berkeleyan—Berkeleyan Publishing Co.		2 50
	Washing towels—C. Howard		10 00
	Washing towels—C. Howard		6 00
8	pkgs. toilet paper—John Maison		50
16,300	cu. ft. gas—Oakland Gas L. & H. Co.		32 60
13,000	cu. ft. gas—Oakland Gas L. & H. Co.		26 00
	Labor, month of December		24 80
1	No. 2 "Cottage Home" stove—M. De La Montanya		8 00
29,000	manilla envelopes—Blake, Moffitt & Towne		90 00
	Labor, month of January, 1896		26 00
7	locks—C. L. Maxwell & Sons		3 50
	Washing towels—C. Howard		5 00
200	ft. 4″ soil pipe—Crane Co.		36 00
36	ft. 4″ hooks—Crane Co.		3 00
1	bale oakum—Crane Co.		3 25
	Labor, month of February		25 00
13,700	cu. ft. gas—Oakland Gas L. & H. Co.		27 40
11,000	cu. ft. gas—Oakland Gas L. & H. Co.		22 00
10	sacks sawdust—G. C. Pape		2 50
	Labor, month of March		26 00
10,000	cu. ft. gas—Oakland Gas L. & H. Co.		20 00
	Subscription to A B C Guide, 1896—Bishop's A B C Guide		5 00
13,200	cu. ft. gas—Oakland Gas L. & H. Co.		26 40
	Labor, month of April		26 00
5,500	cu. ft. gas—Oakland Gas L. & H. Co.		11 00
	Labor, month of May		26 00
			$1,714 64

APPENDIX No. 2 C—*Administration—Repairs.*

25	doz. towels—C. Howard		$10 00
17½	doz. towels—C. Howard		7 00
	Labor, month of June		57 50
	Blue chalk—Schmitt & Zehner		25
	Carpet thread—M. C. Hamlin		10
	Carpet needles—A. Erlandsen		10
4	lock nuts—B. E. Underwood		25
600	lbs. sheet lead—G. H. Tay Co.		33 95
	Connections for automatic closet—Sanitary Plumbing Co.		14 00
540	ft. pine lumber—Pacific Lumber Co.		6 85
2½	M. fancy shingles—Pacific Lumber Co.		6 13
2,015	ft. surfaced redwood—Pacific Lumber Co.	$50 00	
1,008	ft. surfaced redwood—Pacific Lumber Co.	25 00	
41½	M. shingles—Pacific Lumber Co.	62 25	
28½	M. shingles—Pacific Lumber Co.	42 75	

Administration—Repairs—Continued.

10 M. fancy shingles—Pacific Lumber Co.	$25 00	
1,010 ft. sugar pine—Pacific Lumber Co.	60 00	
	$265 00	
Less 2%	5 30	
		$259 70
Labor—L. Mason		24 00
2,000 ft. redwood—Henry W. Taylor		28 80
1,348 ft. pine—Henry W. Taylor		16 98
500 ft. sugar pine—Henry W. Taylor		22 50
Labor, month of July		97 00
24 bushings—Dunham, Carrigan & Hayden Co.		24
3 doz. stopcocks—Dunham, Carrigan & Hayden Co.		13 00
1 stovepipe holder, for bench—Dunham, Carrigan & Hayden Co.		3 35
5¼ lbs. block tin—Dunham, Carrigan & Hayden Co.		92
2 boxes IX Dean tin—Dunham, Carrigan & Hayden Co.		13 50
36 lock nuts—Dunham, Carrigan & Hayden Co.		71
30 gals. gasoline—Dunham, Carrigan & Hayden Co.		7 50
240 bushings—Miller, Sloss & Scott		2 44
144 galv. nipples—Miller, Sloss & Scott		3 24
2 12-lb. soldering coppers—Miller, Sloss & Scott		3 00
24 unions—Miller, Sloss & Scott		1 50
36 ¾″ and 1″ garden valves—Miller, Sloss & Scott		13 08
½ ton Cumberland coal—Miller, Sloss & Scott		7 50
112 lbs. bicarb. soda—J. Caire Co.		3 30
10 lbs. sulph. acid—J. Caire Co.		2 37
Labor, month of August		25 20
10 pkgs. lampblack—S. Wakeham		50
3 2″ bends—B. E. Underwood		75
3 2″ double hubs—B. E. Underwood		60
2 4″ double hubs—B. E. Underwood		50
5 ft. 2″ cast iron—B. E. Underwood		65
5 gross plumbago washers—G. H. Tay Co.		5 00
2 doz. plumbago washers—G. H. Tay Co.		30
1 stovepipe former—G. H. Tay Co.		14 40
1 burning machine—G. H. Tay Co.		8 10
24 return bends, ¾″ and 1″—G. H. Tay Co.		1 37
1 pr. soldering coppers—G. H. Tay Co.		1 10
24 1¼″ plugs—G. H. Tay Co.		48
12 2″ lock nuts—G. H. Tay Co.		43
24 ⅜″x¼″ bushings—G. H. Tay Co.		24
18 doz. assorted galv. nipples—G. H. Tay Co.		3 95
9 doz. assorted black nipples—G. H. Tay Co.		4 83
6 doz. assorted galv. elbows—G. H. Tay Co.		1 60
100 ft ⅛″ bronzed pipe—G. H. Tay Co.		3 75
100 ft. ¼″ bronzed pipe—G. H. Tay Co.		1 75
100 ft. ⅜″ bronzed pipe—G. H. Tay Co.		1 75
300 ft. 1″ galv. pipe—G. H. Tay Co.		16 50
100 ft. 1″ black pipe—G. H. Tay Co.		3 75
100 ft. ¾″ black pipe—G. H. Tay Co.		5 50
200 ft. 1½″ black pipe—G. H. Tay Co.		12 50
200 ft. ½″ black pipe—G. H. Tay Co.		4 50
150 ft. ½″ galv. pipe—G. H. Tay Co.		5 25
6 2″ gate valves—G. H. Tay Co.		13 50
6 1½″ gate valves—G. H. Tay Co.		9 00
6 1¼″ gate valves—G. H. Tay Co.		6 30
6 valves with floats—G. H. Tay Co.		10 50
2 doz. ½″ comp. bibbs—G. H. Tay Co.		5 94
1 doz. ¾″ comp. bibbs—G. H. Tay Co.		5 40
6 2″ black unions—G. H. Tay Co.		1 20
24 1¼″ black unions—G. H. Tay Co.		2 76
24 1″ black unions—G. H. Tay Co.		2 04
12 1″ hose couplings—G. H. Tay Co.		1 10
12 1″ clamps—G. H. Tay Co.		50
Repairs to chemical engine—W. T. Y. Schenck		20 00
Repairs to Babcock extinguisher—W. T. Y. Schenck		15 00
4 charges for chemical engine—W. T. Y. Schenck		10 00
Labor—G. H. Brown		90 00
Labor, month of August		27 00
6 1½″ black tees—R. N. Wood		75
1 pr. B. and hangers—C. L. Maxwell & Sons		1 25
14 ft. track—C. L. Maxwell & Sons		1 40
1 pr. sash lifts—C. L. Maxwell & Sons		35
1 pr. B. D. hangers—C. L. Maxwell & Sons		1 25

Administration—Repairs—Continued.

8	ft. track—C. L. Maxwell & Sons	$0 80
2	drawer pulls—C. L. Maxwell & Sons	65
1	Golden Gate valve—R. N. Wood	3 00
100	ft. picture molding—Johnson & Cavan	1 00
10	Yale key blanks—A. Erlandsen	85
	Washing towels—C. Howard	6 00
12	pieces 4″ sewer pipe—Barker & Hunter Co.	2 35
2	4″ bends—Barker & Hunter Co.	
1	4″ tee—Barker & Hunter Co.	
17	lbs. 3d nails—Schmitt & Zehner	1 00
1	keg 3d wire nails—A. Erlandsen	4 20
	Labor, month of September	24 00
6	1½″ fire gate valves, with cap—G. H. Tay Co.	16 17
6	1½″ street elbows—G. H. Tay Co.	80
	Labor, month of October	27 00
6	Yale key blanks—C. L. Maxwell & Sons	75
	Labor, month of November	26 00
4	key blanks—C. L. Maxwell & Sons	50
	Labor, month of December	24 80
1	pr. butts—C. L. Maxwell & Sons	1 50
	Labor, month of January, 1896	26 00
10	sacks sawdust—Geo. C. Pape	2 50
117	ft. pine lumber—Pacific Lumber Co.	1 90
	Repairs to library clock—M. C. Kittredge	1 25
	Examination of sewerage—C. E. Grunsky	37 50
	Examination of sewerage—F. B. Thompson	2 50
2	lbs. ivory black—W. P. Fuller & Co.	70
3	6″ traps—Gladding, McBean & Co.	5 25
1	door astragal—Niehaus Bros. Co.	1 00
1	4″x 6″ tee—Gladding, McBean & Co.	70
2	4″ bends—Barker & Hunter Co.	50
	Labor, month of February	25 00
40	ft. hose for fire extinguishers—New York Belting & Packing Co.	6 00
	Picture wire—C. L. Maxwell & Sons	75
	Labor, month of March	26 00
	Repairing satchel—S. Taylor	15
3	qts. green paint—W. P. Fuller & Co.	3 00
1	door lock—Central Hardware Co.	2 50
	Labor, month of April	26 00
1	key blank—A. Erlandsen	10
	Supplying clean towels—C. Howard	4 00
	Carpenter work in gymnasium—G. H. Brown	7 50
2	4″ bends—Barker & Hunter Co.	50
	Supplying clean towels—C. Howard	4 50
1	key—John Simon	25
3	4″ bends—Barker & Hunter Co.	75
1	piece gimp—Hulse, Bradford & Co.	60
2½	yds. felt—J. J. O'Brien & Co.	2 00
	Supplying clean towels—C. Howard	5 00
	Labor, month of May	26 00
		$1,373 02

Appendix No. 2 D—*Administration—Advertising and Printing.*

	Printing 500 copies report of Academic Council—C. A. Murdock & Co.	$13 00
	Printing 300 copies report of E. S. Holden	8 00
	Examination papers—C. A. Murdock & Co.	16 00
	Advertising for proposals for painting buildings—	
	San Francisco Bulletin	2 50
	San Francisco Call	3 50
	San Francisco Chronicle	3 50
	San Francisco Examiner	3 50
	San Francisco Report	2 50
	San Francisco Post	3 00
	Oakland Times	3 50
	Oakland Tribune	2 10
	Oakland Enquirer	1 75
50	circulars Hearst Scholarship—C. A. Murdock & Co.	1 50
70	examination cards—C. A. Murdock & Co.	1 50
	Binding 1,000 pamphlets—J. B. McIntyre	3 50
10,000	examination blanks—Blake, Moffitt & Towne	40 00
	Advertising for proposals for Cadet uniforms—	
	San Francisco Chronicle	3 50
	San Francisco Examiner	3 80

Administration—Advertising and Printing—Continued.

Advertising for proposals for Cadet uniforms—Continued.	
San Francisco Bulletin	$2 50
San Francisco Call	3 50
San Francisco Post	1 80
Oakland Times	1 50
Oakland Enquirer	1 90
Oakland Tribune	2 10
75 Greek examination papers—J. S. Cushing & Co.	4 50
	$134 45

APPENDIX No. 2 E—*Administration—Telegraphing and Expressage.*

Exchange on Controller's warrants—Louis Sloss, Treasurer	$28 50
Telegraphing—Western Union Tel. Co.	2 00
Telegraphing—Western Union Tel. Co.	40
Expressage—Wells, Fargo & Co.	5 20
Expressage—Patterson & Co.	24 88
Exchange on Controller's warrants—Louis Sloss, Treasurer	55
Exchange on Eastern drafts—Louis Sloss, Treasurer	80
Fees on money orders—John McCarthy, P. M.	57
Rental of telephone, July and August—Sunset Tel. & Tel. Co.	15 60
Exchange on Controller's warrants—Louis Sloss, Treasurer	21 87
Expressage—Wells, Fargo & Co.	2 85
Expressage—Patterson & Co.	8 00
Expressage—Patterson & Co.	24 75
Fees on money orders—John McCarthy, P. M.	66
Expressage—Patterson & Co.	31 73
Expressage—Wells, Fargo & Co.	27 35
Exchange on Controller's warrants—Louis Sloss, Treasurer	1 51
Expressage—Louis Sloss, Treasurer	75
Rental of telephone, September—Sunset Tel. & Tel. Co.	8 70
Telegraphing—Western Union Tel. Co.	3 03
Fees on money orders—J. McCarthy, P. M.	31
Exchange on Eastern drafts—Louis Sloss, Treasurer	1 50
Telegraphing—Western Union Tel. Co.	2 00
Telegraphing—Western Union Tel. Co.	2 00
Telegraphing—Western Union Tel. Co.	2 36
Expressage—Wells, Fargo & Co.	75
Rent of telephone, October—Sunset Tel. & Tel. Co.	8 40
Fees on money orders—J. McCarthy, P. M.	15
Exchange on Eastern drafts—Louis Sloss, Treasurer	50
Expressage—Wells, Fargo & Co.	2 95
Expressage—Wells, Fargo & Co.	3 40
Expressage—Patterson & Co.	14 41
Expressage—Patterson & Co.	1 00
Rent of telephone, November—Sunset Tel. & Tel. Co.	7 65
Exchange on Eastern drafts—Louis Sloss, Treasurer	25
Fees on money orders—John McCarthy, P. M.	27
Exchange on Eastern drafts—Louis Sloss, Treasurer	25
Expressage—Wells, Fargo & Co.	25
Fees on money orders—John McCarthy, P. M.	03
Telegraphing—Western Union Tel. Co.	2 83
Expressage—Wells, Fargo & Co.	4 45
Rental of telephone, December—Sunset Tel. & Tel. Co.	7 50
Fees on money orders—John McCarthy, P. M.	1 32
Expressage—Wells, Fargo & Co.	2 30
Expressage—Patterson & Co.	16 53
Expressage—Patterson & Co.	2 58
Rental of telephone, January, 1896—Sunset Tel. & Tel. Co.	9 95
Exchange on Eastern drafts—Louis Sloss, Treasurer	60
Exchange on Eastern drafts—Louis Sloss, Treasurer	75
Exchange on Eastern drafts—Louis Sloss, Treasurer	1 00
Exchange on Controller's warrants—Louis Sloss, Treasurer	17 55
Expressage—Wells, Fargo & Co.	5 60
Expressage—Patterson & Co.	4 50
Rental of telephone, February, 1896—Sunset Tel. & Tel. Co.	8 75
Expressage—Wells, Fargo & Co.	60
Fees on money orders—John McCarthy, P. M.	51
Fees on money orders—John McCarthy, P. M.	26
Telegraphing—Western Union Tel. Co.	4 10
Exchange on Eastern drafts—Louis Sloss, Treasurer	25
Exchange on Controller's warrants—Louis Sloss, Treasurer	57 30
Expressage—Wells, Fargo & Co.	10 00
Expressage—Patterson & Co.	4 00

Administration—Telegraphing and Expressage— Continued.

Exchange on Eastern drafts—Louis Sloss, Treasurer	$2 25
Rental of telephone, March—Sunset Tel. & Tel. Co.	8 10
Fees on money orders—John McCarthy, P. M.	10
Fees on money orders—John McCarthy, P. M.	42
Telegraphing—Western Union Tel. Co.	5 91
Exchange on Eastern drafts—Louis Sloss, Treasurer	1 25
Fees on money orders—John McCarthy, P. M.	66
Expressage—Patterson & Co.	1 25
Expressage—Wells, Fargo & Co.	2 65
Rental of telephone, April—Sunset Tel. & Tel. Co.	9 75
Fees on money orders—John McCarthy, P. M.	18
Exchange on Eastern drafts—Louis Sloss, Treasurer	1 20
Exchange on Eastern drafts—Louis Sloss, Treasurer	1 00
Expressage—Wells, Fargo & Co.	5 11
Expressage—Patterson & Co.	21 00
Rental of telephone, May—Sunset Tel. & Tel. Co.	8 50
Exchange on Eastern drafts—Louis Sloss, Treasurer	25
Fees on money orders—John McCarthy, P. M.	16
Fees on money orders—John McCarthy, P. M.	29
Telegraphing—Western Union Tel. Co.	18 93
Exchange on Controller's warrants—Louis Sloss, Treasurer	37 50
Cartage and freight, Los Angeles—A. G. Van Gorden	2 19
Expressage—Wells, Fargo & Co.	1 35
Expressage—Wells, Fargo & Co.	3 50
Expressage—Wells, Fargo & Co.	8 20
Expressage—Patterson & Co.	10 50
Exchange on Eastern money orders—John McCarthy, P. M.	70
Exchange on Eastern money orders—Louis Sloss, Treasurer	25
Exchange on Eastern money orders—John McCarthy, P. M.	03
Exchange on Eastern money orders—John McCarthy, P. M.	58
Exchange on Eastern money orders—Louis Sloss, Treasurer	50
Exchange on Eastern money orders—Louis Sloss, Treasurer	25
Exchange on Eastern money orders—John McCarthy, P. M.	03
Telegrams—Western Union Tel. Co.	1 90
Express—Wells, Fargo & Co.	7 50
Telephone—Sunset Tel. & Tel. Co.	9 40
	$594 70

Appendix No. 2 F—*Administration—Stationery.*

2	gross rubber bands—Cunningham, Curtiss & Welch	$1 80
2,000	envelopes—Blake, Moffitt & Towne	6 00
500	envelopes—Blake, Moffitt & Towne	50
150	mailing tubes—Cunningham, Curtiss & Welch	3 00
1,000	envelopes—Blake, Moffitt & Towne	3 50
2	student's deposit receipt books—Hicks-Judd Co.	9 00
1	qt. ink—McNutt, Kahn & Co.	60
12	qts. Barnes' ink—H. S. Crocker Co.	4 50
12	qts. Pomeroy mucilage—H. S. Crocker Co.	8 00
	A B C Guide, November, 1894, to November, 1895	5 00
½	doz. carbon paper—E. W. Hill	3 50
	Binding 1 book—J. B. McIntyre	2 25
5	rms. Westlock demy—Dutton & Partridge	20 40
12	copying books—Dutton & Partridge	15 00
11	student's deposit receipt books—Dutton & Partridge	49 50
250	mortgage blank notes—Hinton Printing Co.	2 50
½	doz. ribbons for typewriter—Scott & Bannan	4 50
1	shield for typewriter—Scott & Bannan	10
1	bottle of ink—Scott & Bannan	25
1	desk diary—Dutton & Partridge	1 25
	Binding 250 reports—J. B. McIntyre	1 50
1	student's deposit receipt book—Dutton & Partridge	4 50
	Binding 1,750 joint regulations—J. B. McIntyre	3 50
100	carbons—S. F. Typewriter Exchange	3 60
¼	rm. journal paper—Dutton & Partridge	1 50
1	bottle of oil—S. F. Typewriter Exchange	20
1	eraser—S. F. Typewriter Exchange	10
	Binding 1,700 Freshman lists—J. B. McIntyre	1 50
100	memo. pads—Blake, Moffitt & Towne	4 50
1	box of rubber bands—Brown & Power	15
	Stitching salary rolls—Hicks-Judd Co.	75
1	rm. onion skin folio—Blake, Moffitt & Towne	4 85
1	knife eraser—Brown & Power	50
6	Globe transfer cases—Cunningham, Curtiss & Welch	2 10

Administration—Stationery—Continued.

6 Globe index cases—Cunningham, Curtiss & Welch	$2 40
1 qt. mucilage—Cunningham, Curtiss & Welch	1 00
3 qts. ink—Cunningham, Curtiss & Welch	2 95
1 ruling pen—Cunningham, Curtiss & Welch	75
3 gross pens—Cunningham, Curtiss & Welch	1 75
250 mourning envelopes—Blake, Moffitt & Towne	1 50
1 doz. Cyclone files—Brown & Power	3 50
4 diaries—Brown & Power	2 00
1 ball twine—Brown & Power	10
1 box gold seals—C. G. Hardy	25
1 rm. onion skin folio—Blake, Moffitt & Towne	4 95
400 gold seals—Brown & Power	1 00
2 check books—Hicks-Judd Co.	13 00
24 sets Treasurer's reports—Dutton & Partridge	6 50
12 check books, student's deposits—Dutton & Partridge	11 25
2 gross rubber bands—Dutton & Partridge	75
100 carbons—S. F. Typewriter Exchange	3 60
Ruling blanks—Blake, Moffitt & Towne	75
250 Manilla envelopes—Blake, Moffitt & Towne	1 50
2 quires manilla paper—Blake, Moffitt & Towne	80
1 ball twine—Blake, Moffitt & Towne	10
50 sheets blotting paper—Blake, Moffitt & Towne	1 50
100 sheets carbon paper—S. F. Typewriter Exchange	3 60
170 sheets onion skin paper—Blake, Moffitt & Towne	1 80
6 memo. books—Payot, Upham & Co.	1 40
1 gross pens—Payot, Upham & Co.	75
1 journal—Payot, Upham & Co.	65
1 jar paste—Student's Coöp. Ass'n	15
3¼ doz. pencils—Cunningham, Curtiss & Welch	1 00
1 quire paper and envelopes—Hartwell, Mitchell & Willis	1 25
½ doz. Koh-Inor pencils—Sanborn, Vail & Co.	50
2,000 No. 1 flathead fasteners—Brown & Power	1 50
100 sheets cobweb carbon—Payot, Upham & Co.	4 35
2 Crocker-Langley Directories—H. S. Crocker Co.	10 00
	$259 25

APPENDIX No. 2 G—*Administration—Postage.*

Postage stamps—John McCarthy, P. M.	$200 00
Postal cards—John McCarthy, P. M.	2 00
Postage stamps—John McCarthy, P. M.	50 00
Postal cards—John McCarthy, P. M.	3 00
Postage stamps—John McCarthy, P. M.	50 00
Postage stamps—John McCarthy, P. M.	100 00
Postage stamps—John McCarthy, P. M.	100 00
Postal cards—John McCarthy, P. M.	2 00
300 1c. stamps—John McCarthy, P. M.	3 00
Postage stamps—John McCarthy, P. M.	46 50
Postage stamps—John McCarthy, P. M.	46 50
	$603 00

APPENDIX No. 2 H—*Administration—Official and Lecturing Expenses.*

Traveling expenses—F. Slate	$54 80
Traveling expenses—A. B. Pierce	39 65
Traveling expenses—W. D. Armes	33 10
Traveling expenses—M. W. Haskell	11 40
Traveling expenses—E. R. Drew	14 50
Premium on Secretary's bond—Pacific Surety Co.	50 00
Premium on Assistant Secretary's bond—Pacific Surety Co.	50 00
Clerical work, Recorder's office—H. B. Torrey	50
Clerical work, Recorder's office—H. B. Torrey	75
Traveling expenses—L. D. Syle	1 40
Clerical work, Recorder's office—R. H. Sherman	12 20
Clerical work, Recorder's office—R. H. Sherman	11 90
Conducting entrance examinations—L. R. Hewitt	20 00
Clerical work, Recorder's office—C. H. Harwood	10 00
Clerical work, Recorder's office—C. H. Harwood	8 50
Clerical work, Recorder's office—W. H. Graves	2 50
Traveling expenses—D. W. Gilbert	6 15
Traveling expenses—J. H. C. Bonté	4 10
Notary fees—J. R. Little	50
Traveling expenses—D. W. Gilbert	3 10
Typewriting bonds of indemnity—H. C. Warren	1 50
Traveling expenses—W. C. Jones	100 00

Administration—Official and Lecturing Expenses—Continued.

Traveling expenses—D. W. Gilbert	$3 40
Traveling expenses—J. H. C. Bonté	4 40
Traveling expenses—W. H. Phipps	1 15
Notary fees—J. R. Little	50
Clerical work—C. H. Harwood	7 00
Traveling expenses—E. B. Clapp	12 60
Rent of Style's Hall—A. S. Blake, Secretary	3 00
Clerical work—F. W. Koch	5 17
Clerical work—R. H. Sherman	34 25
Clerical work—J. A. Elston	12 42
Traveling expenses—A. F. Lange	11 80
Traveling expenses—D. W. Gilbert	4 70
Traveling expenses—D. W. Gilbert	3 45
Traveling expenses—J. H. C. Bonté	3 10
Recording Sutro deed—T. J. Glynn, Recorder	7 00
Traveling expenses—J. H. C. Bonté	7 00
Traveling expenses—D. W. Gilbert	4 15
Clerical work—R. A. McKenzie	2 75
Clerical work—J. A. Elston	13 12
Clerical work—Geo. Battelle	5 00
Clerical work—R. A. Knight	3 50
Clerical work—J. A. Elston	4 50
Clerical work—H. A. Overstreet	7 00
Traveling expenses—W. A. McKowen	10 40
Traveling expenses—D. W. Gilbert	4 60
Traveling expenses—J. H. C. Bonté	4 00
Typewriting 3 deeds—Misses Shephard	2 80
Typewriting 3 agreements—Misses Shephard	1 25
Traveling expenses—J. H. C. Bonté	4 20
Clerical work—L. S. Griswold	2 00
Traveling expenses—D. W. Gilbert	4 75
Notary fees—M. C. Hamlin	50
Clerical work—R. A. McKenzie	2 25
Clerical work—A. V. Stubenrauch	3 50
Clerical work—J. A. Elston	4 06
Clerical work—H. A. Overstreet	2 25
Clerical work—H. A. Overstreet	50
Traveling expenses—D. W. Gilbert	6 70
Traveling expenses—E. B. Clapp	57 65
Traveling expenses—W. A. Merrill	99 20
Traveling expenses—C. C. Plehn	111 05
Traveling expenses—M. W. Haskell	32 40
Traveling expenses—D. W. Gilbert	5 70
Traveling expenses—J. H. C. Bonté	4 45
Traveling expenses—J. H. C. Bonté	4 25
Traveling expenses—A. F. Lange	33 75
Traveling expenses—F. Slate	135 35
Traveling expenses—C. B. Bradley	44 40
Traveling expenses—W. A. McKowen	7 80
Traveling expenses—D. W. Gilbert	8 00
Traveling expenses—I. Flagg	2 00
Traveling expenses—W. A. Merrill	33 15
Traveling expenses—Carl C. Plehn	37 55
Traveling expenses—E. P. Lewis	6 30
Traveling expenses—E. R. Drew	44 90
Clerical work—H. A. Overstreet	1 40
Clerical work—J. A. Elston	2 68
Clerical work—H. A. Overstreet	1 25
Clerical work—G. D. Leslie	2 50
Traveling expenses—Wm. D. Armes	5 30
Traveling expenses—F. Slate	24 80
Traveling expenses—I. Stringham	107 60
Traveling expenses—C. M. Gayley	91 00
Traveling expenses—L. T. Hengstler	5 90
Traveling expenses—J. H. C. Bonté	5 10
Traveling expenses—J. H. C. Bonté	3 20
Traveling expenses—C. C. Plehn	27 40
Traveling expenses—C. B. Bradley	13 50
Traveling expenses—D. W. Gilbert	5 90
	$1,616 70

APPENDIX No. 2 I—*Administration—Water.*

Water, month of June, 1895—Alameda Water Co.	$225 00
Water, month of July, 1895—Alameda Water Co.	232 50
Contour map and survey of reservoir site—M. G. King	100 00
Water, month of August, 1895—Alameda Water Co.	232 50
Water, month of September, 1895—Alameda Water Co.	233 45
Water, month of October, 1895—Alameda Water Co.	232 50
Water, month of November, 1895—Alameda Water Co.	225 00
Water, month of December, 1895—Alameda Water Co.	232 50
Reservoir sites—Ann J. Stiles	3,800 00
Abstract of Stiles' lot—Stocker & Holland	5 00
Recording deed to Stiles' lot—Stocker & Holland	1 25
Water, month of January, 1896—Alameda Water Co.	232 50
Water, month of February, 1896—Alameda Water Co.	217 50
Water, month of March, 1896—Alameda Water Co.	232 50
Water, month of April, 1896—Alameda Water Co.	225 00
Taxes 1895-96, reservoir site—Town of Berkeley	12 67
Water, month of May, 1896—Alameda Water Co.	232 50
	$6,672 37

APPENDIX No. 2 J—*Administration—Insurance.*

Insurance on N. K. Masten's property—J. C. Mitchell & Son	$19 15
Insurance on military goods, arms, etc.—J. C. Mitchell & Son	84 20
Insurance on military goods, arms, etc.—J. C. Mitchell & Son	20 40
Insurance on military goods, arms, etc.—New Zealand Ins. Co.	16 85
Insurance on military goods, arms, etc.—New Zealand Ins. Co.	21 65
	$162 25

APPENDIX No. 2 K—*Administration—College Celebrations.*

Engrossing diplomas—T. R. Southern	$8 00
150 diplomas—Schmidt Label & Litho. Co.	225 00
Engrossing diploma—Schmidt Label & Litho. Co.	50
9 diplomas—Schmidt Label & Litho. Co.	18 00
Engrossing 134 diplomas—T. R. Southern	67 00
	$318 50

APPENDIX No. 2 L—*Administration—Publications.*

300 copies Miss Shinn's "Notes on the Development of a Child"—Berkeley Advocate	$37 00

APPENDIX No. 3 A—*Agricultural Experiment Stations—Labor.*

Labor, month of June—Amador Station	$80 95
Labor, month of June—Tulare Station	43 75
Labor, month of June—Paso Robles Station	60 25
Labor, month of June—Pomona Station	56 22
Labor, month of June—Central Station	25 00
Labor—Isadore Le Duc	6 00
	$272 17

APPENDIX No. 3 B—*Agricultural Experiment Stations—Publications.*

2 electrotypes—Hanson Bros.	$1 20
Zinc reductions—Dewey Engraving Co.	7 00
10 photo half-tones, copper—Union Photo Engraving Co.	64 40
22 photo half-tones, copper—Union Photo Engraving Co.	40 00
4 photo half-tones, copper—Union Photo Engraving Co.	16 10
8 zincographs—Union Photo Engraving Co.	18 48
14 zincographs—Union Photo Engraving Co.	10 50
	$157 68

APPENDIX No. 3 C—*Agricultural Experiment Stations—Postage and Stationery.*

3 quires cap combination—G. G. Wickson & Co.	$3 00	
25 sheets stencil letter—G. G. Wickson & Co.	90	
1 tube mim. ink—G. G. Wickson & Co.	75	
3 bottles mim. varnish—G. G. Wickson & Co.	75	
4 bottles T. W. oil—G. G. Wickson & Co.	80	
2 oil cans—G. G. Wickson & Co.	50	
3 type brushes—G. G. Wickson & Co.	75	
1 box carbon—G. G. Wickson & Co.	3 50	
3 copy holders—G. G. Wickson & Co.	6 00	
	$16 95	
Discount	1 70	
		$15 25

Agricultural Experiment Stations—Postage and Stationery—Continued.

6 sheets bristol board—Brown & Power	$0 30
24 balls twine—Brown & Power	2 40
2 4-quire record books—Brown & Power	14 75
1 box pens—Brown & Power	30
6 pyramids pins—Brown & Power	35
2 qts. black ink—Brown & Power	2 25
1 doz. note books—Brown & Power	40
6 sheets drawing paper—Le Count Bros.	25
24 balls twine—Le Count Bros.	1 33
6 copy books—Le Count Bros.	4 50
2,000 shipping tags—Le Count Bros.	1 00
2½ gross blotters—Le Count Bros.	1 02
2 doz. oil boards—Le Count Bros.	40
2 qts. crimson ink—Le Count Bros.	1 80
4 qts. mucilage—Le Count Bros.	84
1 doz. letter files—Le Count Bros.	3 00
4 gross pens—Le Count Bros.	2 10
1 copy book—L. B. Mandel & Co.	2 10
Postage stamps—John McCarthy, P. M.	30 00
1 font type—L. H. Moise	2 75
2 pads—L. H. Moise	1 00
1 gross pencils—Payot, Upham & Co.	3 78
1 box fasteners—Payot, Upham & Co.	30
2 bottles India ink—Payot, Upham & Co.	46
3 boxes rubber bands—Payot, Upham & Co.	70
3 envelope openers—Payot, Upham & Co.	30
	$93 63

Appendix No. 3 D—*Agricultural Experiment Stations—Freight and Expressage.*

Freightage—Southern Pacific Co.	$0 69
Freightage—Southern Pacific Co.	65
Freightage—Southern Pacific Co.	25
Freightage—E. Ginocchio & Bro.	3 85
Freightage—E. Ginocchio & Bro.	35
Expressage—Wells, Fargo & Co.	2 90
Freightage—Gladding, McBean & Co.	58 20
Expressage—Wells, Fargo & Co.	2 15
Expressage—Patterson & Co.	6 75
	$75 79

Appendix No. 3 E—*Agricultural Experiment Stations—Heat, Light, and Water.*

4 cases coal oil—Poston & Hamlin	$10 00
4,000 lbs. coal—Paine & Hunter	20 00
1 galv. tee—Grangers' Union	20
1 galv. nipple—Grangers' Union	10
Labor on pipe—Grangers' Union	25
Water at Amador Station—Blue Lakes Water Co.	9 00
12 cords wood—E. K. Black	36 00
1,620 ft. vitrified water pipe—Gladding, McBean & Co.	85 05
15 tees for above—Gladding, McBean & Co.	3 15
5 elbows for above—Gladding, McBean & Co.	88
1 Y for above—Gladding, McBean & Co.	21
10 cords wood—J. W. Casteel	35 00
	$199 84

Appendix No. 3 F—*Agricultural Experiment Stations—Chemical Supplies.*

2 lbs. alum—J. Caire Co.	$0 08
4 ozs. tylol—J. Caire Co.	45
5 doz. rubber stoppers—J. Caire Co.	3 50
1 globe tunnel and cork—J. Caire Co.	90
1 open-top funnel and stopcock—J. Caire Co.	1 10
2 sets cork-borers—J. Caire Co.	3 40
1 set bits—J. Caire Co.	1 75
1 ratchet brace—J. Caire Co.	2 00
1 extension bit—J. Caire Co.	1 25
1 clawhammer—J. Caire Co.	60
1 set assorted files, large size—J. Caire Co.	3 50
1 set assorted files, small size—J. Caire Co.	2 00
4 prs. scissors—J. Caire Co.	2 00
12 pkgs. assorted tacks—J. Caire Co.	65
10 lbs. wire nails—J. Caire Co.	60

Agricultural Experiment Stations—Chemical Supplies—Continued.

6 dropping bottles, glass stoppers—J. Caire Co.	$1 50
1 pr. patent forceps—J. Caire Co.	1 50
1 steel mortar—J. Caire Co.	3 00
1 Troemner scale, with brass weights—J. Caire Co.	14 40
½ doz. 15-grm. chloride of gold—John Taylor & Co.	2 88
3 ozs. eikonogen—John Taylor & Co.	1 14
2 lbs. conct. borax—John Taylor & Co.	16
4 ozs. benzole—John Taylor & Co.	30
4 ozs. oil of cloves—John Taylor & Co.	30
1 lb. chloroform—John Taylor & Co.	75
1 2-oz. funnel—John Taylor & Co.	70
1 4-oz. funnel—John Taylor & Co.	1 00
1 7-oz. funnel, bell-shape—John Taylor & Co.	90
90 lbs. 3 F ammonia—John Taylor & Co.	9 45
5 doz. assorted flat wicks—John Taylor & Co.	99
2 glass retorts—John Taylor & Co.	60
12 cylinder graduates—John Taylor & Co.	6 96
6 porcelain casseroles—John Taylor & Co.	1 98
3 gross extra flint bottles and corks—John Taylor & Co.	15 75
12 test-tube swabs—John Taylor & Co.	60
32 pkgs. assorted C. S. & S. filters—John Taylor & Co.	29 76
12 assorted screw clips—John Taylor & Co.	3 00
¼ lb. salicylic acid—John Taylor & Co.	25
3 lbs. pure caustic potash—John Taylor & Co.	1 35
1 lb. molybdic acid—John Taylor & Co.	1 65
½ gross test tubes—John Taylor & Co.	1 00
1 doz. bulb glass tubes—John Taylor & Co.	1 80
4 sq. ft. rubber packing—John Taylor & Co.	1 40
6 ft. rubber tubing—John Taylor & Co.	90
1 set agate measures—John Taylor & Co.	2 20
3 evaporating dishes—J. Caire Co.	1 23
6 varieties wine yeast—J. G. Burmanne	9 41
3 gross 16-oz. flint bottles—John Taylor & Co.	31 50
3 gross corks—John Taylor & Co.	
14 pkgs. assorted filters	10 48
	$184 57

Appendix No. 3 G—*Agricultural Experiment Stations—Seeds, Plants, and Sundry Supplies.*

21 assorted trees—California Nursery Co.	$19 85
1,209 tree stakes—Kerckhoff-Cunzer M. and L. Co.	36 44
13 shoes—Garbarini Bros.	6 00
20 doz. Seed dry plates—Henry Kahn & Co.	17 80
6 doz. carbutt lantern plates—Henry Kahn & Co.	3 30
6 doz. cover glasses—Henry Kahn & Co.	1 80
4 printing frames—Henry Kahn & Co.	1 40
1 rubber tray—Henry Kahn & Co.	70
1 velvet cloth—Henry Kahn & Co.	1 00
1 gal. castor oil—Ira F. White & Son	60
1 padlock—Ira F. White & Son	25
Repairs to harness—S. N. Pelton	4 50
8 new shoes—A. Young	3 00
3½ lbs. twine—Grangers' Union	63
1⅝ lbs. rope—Grangers' Union	28
2 hasps and staples—Grangers' Union	10
1 ball twine—Grangers' Union	25
Strap hinges—Grangers' Union	50
Soap and washers—A. T. Preuss	70
12 shoes—W. C. Henderson	4 50
50 cannas—Henry A. Dreer	3 91
1 box cherries—D. & D. Co.	90
4 shoes—Garbarini Bros.	2 00
2 trace-chains—Garbarini Bros.	50
2 hooks—Garbarini Bros.	25
	$111 16

Appendix No. 3 H—*Agricultural Experiment Stations—Fertilizers.*

10 tons gypsum—Paoli Gypsum Co.	$90 00
1,000 ft. 3″ drain tile—Gladding, McBean & Co.	24 00
500 ft. 2″ drain tile—Gladding, McBean & Co.	10 00
10 3″ tees—Gladding, McBean & Co.	2 80
10 2″ reducers—Gladding, McBean & Co.	2 80

Agricultural Experiment Stations—Fertilizers—Continued.

5 3″ elbows—Gladding, McBean & Co.	$1 40
10 3″ Y's—Gladding, McBean & Co.	2 80
5 bbls. Portland cement—Gladding, McBean & Co.	15 00
	$148 80

Appendix No. 3 I—*Agricultural Experiment Stations—Feeding-Stuffs.*

½ ton crushed barley—Congdon & Co.	$8 50
½ ton wheat bran—Congdon & Co.	7 25
Lease of land at Paso Robles—J. C. Johnson & Co.	40 00
	$55 75

Appendix No. 3 J—*Agricultural Experiment Stations—Library.*

United States Dispensatory—J. D. Hammond	$6 40
Claussius Analysis—J. D. Hammond	2 25
Brant's Alcohol—J. D. Hammond	2 00
Brant's Vinegar—J. D. Hammond	4 00
Alkali Trade—J. D. Hammond	2 00
Aniline, etc.—J. D. Hammond	2 00
Gaseous Fuel—J. D. Hammond	45
Petroleum—J. D. Hammond	6 00
Fibres—J. D. Hammond	8 00
Flavoring Extracts—J. D. Hammond	1 50
Franckel's Starch—J. D. Hammond	2 63
Crooke's Analysis—J. D. Hammond	5 34
Analysis of Urine—J. D. Hammond	1 50
Micro-Chem. Analysis—J. D. Hammond	1 20
Webster's Dictionary—J. D. Hammond	8 25
Commission—J. D. Hammond	2 14
Postage—J. D. Hammond	2 35
Stotsmann Muspratt Feibriect, 2 vols.—Mayer & Muller	16 88
	$74 89

Appendix No. 3 K—*Agricultural Experiment Stations—Tools, Implements, and Machinery.*

1 McLeod cultivator—Baker & Hamilton	$30 40	
12 extra weed-cutters—Baker & Hamilton	2 88	
1 fanning mill—Baker & Hamilton	24 00	
		$57 28
Repairing lantern—Garbarini Bros.		50
Repairing wagon—Garbarini Bros.		4 50
Repairing mattock—Garbarini Bros.		75
1 bolt—Garbarini Bros.		25
Sharpening hoe—Garbarini Bros.		50
1 spade—Ira F. White & Son		1 00
1 spade—Ira F. White & Son		1 25
1 oiler—Ira F. White & Son		15
2 hoes—Ira F. White and Son		1 00
1 screwdriver—Ira F. White & Son		40
1 pick handle—Ira F. White & Son		25
1 sledge—Ira F. White & Son		25
Sharpening 3 shares—A. Young		75
Repairing doubletree—W. C. Henderson		75
1 stepladder—G. E. Chittenden		5 00
		$74 58

Appendix No. 3 L—*Agricultural Experiment Stations—Furniture and Fixtures.*

1 bedspread—J. J. O'Brien & Co.	$1 65
4 sheets—J. J. O'Brien & Co.	2 00
4 pillowcases—J. J. O'Brien & Co.	60
1 pr. blankets—J. J. O'Brien & Co.	5 00
1 ¾ iron bed—Indianapolis Furniture Co.	5 00
1 ¾ mattress—Indianapolis Furniture Co.	3 00
1 kitchen table—Indianapolis Furniture Co.	1 50
1 roll-top desk—Indianapolis Furniture Co.	19 00
1 bureau—Indianapolis Furniture Co.	10 00
1 chair—Indianapolis Furniture Co.	4 00
2 chairs—Indianapolis Furniture Co.	2 00
	$53 37

Appendix No. 3 M—*Agricultural Experiment Stations—Scientific Apparatus.*

1 model F 2 microscope—C. C. Riedy	$43 20
1 velvet R. R. lens—Henry Kahn & Co.	8 95
1 Le Mignon shutter—Henry Kahn & Co.	7 50
1 analytical balance—Eimer & Amend	65 00
1 set weights—Eimer & Amend	12 00
2 anemometer registers—J. P. Friez	70 00
2 thermographs—J. P. Friez	90 00
2 photo sunshine recorders—J. P. Friez	51 00
5 No. 1 barometers—Henry J. Green	145 00
3 extra barometer tubes—Henry J. Green	3 75
5 sling psychometers, 6 brushes, and 2 doz. union cases—Henry J. Green	27 50
4 standard thermometers, Fahr. scale, No. 202, and 1 standard thermometer, Cent. scale, No. 206—Henry J. Green	75 00
1 set soil thermometers, Nos. 300 to 307—Henry J. Green	49 50
2 reg. solar radiation thermometers—Henry J. Green	20 00
2 soil thermometers—Henry J. Green	12 37
	$680 77

Appendix No. 3 N—*Agricultural Experiment Stations—Live Stock.*

4 graded Southdown ewes—C. U. Margetts	$10 00

Appendix No. 3 O—*Agricultural Experiment Stations—Traveling.*

Traveling expenses—C. W. Woodworth	$18 00
Traveling expenses—E. Kellner	1 10
	$19 10

Appendix No. 3 P—*Agricultural Experiment Stations—Contingent Expenses.*

Services in making survey and map of Pomona Experiment Station—George Hanson	$50 00
Use of hay rake—Reinhart Bros.	2 50
	$52 50

Appendix No. 3 Q—*Agricultural Experiment Stations—Buildings and Repairs.*

7 gals. white paint—E. G. Buswell Paint Co.	$10 50
1 gal. yellow stone—E. G. Buswell Paint Co	1 50
8 gals. floor paint—E. G. Buswell Paint Co.	10 00
4 gals. inside paint—E. G. Buswell Paint Co.	6 00
1 gal. varnish—E. G. Buswell Paint Co.	4 50
6 qts. red paint—E. G. Buswell Paint Co.	2 00
5 cans carbon black—E. G. Buswell Paint Co.	1 25
1 paint brush—Ira F. White & Son	60
25 lbs. white lead—Ira F. White & Son	1 69
2 gals. boiled oil—Ira F. White & Son	1 68
3 ft. 2″ pipe—Ira F. White & Son	45
11 ft. 1½″ pipe, and 1 ell—Ira F. White & Son	1 43
Plastering—E. B. Robinson	2 50
	$44 10

Appendix No. 4 A—*Agricultural Experiment Stations—Labor.*

July, 1895—	Central Station	$69 20
	Amador Station	86 56
	Tulare Station	42 00
	Paso Robles Station	45 50
	Pomona Station	68 82
Aug., 1895—	Central Station	79 60
	Tulare Station	47 25
	Pomona Station	68 87
	Paso Robles Station	48 75
	Amador Station	54 80
Sept., 1895—	Central Station	51 70
	Amador Station	47 50
	Tulare Station	92 75
	Paso Robles Station	45 50
	Pomona Station	50 75
Oct., 1895—	Pomona Station	133 47
	Tulare Station	69 75
	Paso Robles Station	51 75
	Amador Station	51 30
	Central Station	87 10
	Isadore Le Duc (3 days)	3 75

Agricultural Experiment Stations—Labor—Continued.

Nov., 1895—	Central Station	$32 10
	Amador Station	53 20
	Tulare Station	45 50
	Paso Robles Station	78 50
	Pomona Station	188 97
Dec., 1895—	Pomona Station	91 67
	Central Station	32 60
	Paso Robles Station	89 00
	Tulare Station	45 50
	Amador Station	49 40
Jan., 1896—	Central Station	42 90
	Amador Station	51 30
	Tulare Station	72 75
	Pomona Station	72 75
	Paso Robles Station	71 00
Feb., 1896—	Amador Station	60 00
	Paso Robles Station	72 50
	Pomona Station	58 95
	Tulare Station	92 50
	Central Station	109 30
Mar., 1896—	Central Station	215 00
	Pomona Station	130 85
	Tulare Station	127 00
	Paso Robles Station	97 00
	Amador Station	90 74
Apr., 1896—	Amador Station	91 00
	Tulare Station	102 50
	Pomona Station	90 42
	Paso Robles Station	54 32
	Chino Station	4 00
May, 1896—	R. A. Gould	13 20
	Pomona Station	103 75
	Tulare Station	50 00
	Paso Robles Station	112 62
	Jackson Station	91 75
		$4,081 21

Appendix No. 4 B—*Agricultural Experiment Stations—Publications.*

2	zinc etchings—Union Photo Engraving Co.	$4 50
2	copper half-tone photos—Union Photo Engraving Co.	10 60
40,000	Manilla envelopes—Blake, Moffitt & Towne	97 35
1	rep. elevations—Union Photo Engraving Co.	70
1	rep. platting—Union Photo Engraving Co.	1 68
1	rep. platting—Union Photo Engraving Co.	91
1	half-tone leaves—Union Photo Engraving Co.	2 00
		$117 74

Appendix No. 4 C—*Agricultural Experiment Stations—Postage and Stationery.*

1	receipt book—Southern Pacific Co.	$0 25
	Postage stamps—John McCarthy, P. M.	15 00
3	doz. letter pads—Payot, Upham & Co.	1 55
3	rms. letter paper—Payot, Upham & Co.	2 25
2	doz. blue pencils (Faber)—Payot, Upham & Co.	1 45
1¼	doz. rulers—Payot, Upham & Co.	70
2	doz. note books—Payot, Upham & Co.	70
1	box McGill fasteners—Payot, Upham & Co.	08
1	box McGill fasteners—Payot, Upham & Co.	12
2	gross Gillott's pens—Payot, Upham & Co.	80
1	doz. large blotters—Payot, Upham & Co.	45
2	rms. Manilla paper—Payot, Upham & Co.	3 00
	Postage stamps—John McCarthy, P. M.	25 00
8	rms. letter paper—Payot, Upham & Co.	6 80
2	daily journals—E. P. Taylor	2 50
12	penholders—Brown & Power	40
1	blotter holder—C. G. Hardy	60
1	doz. imperial sheets—Students Coöp. Ass'n	1 20
	Postage stamps—John McCarthy, P. M.	25 00
36	blank books—Brown & Power	1 50
7,000	letterheads—Brown & Power	7 00
24	sheets drawing paper—Brown & Power	1 20
11	doz. pads—Brown & Power	5 50
4	copy baths—Brown & Power	3 00
4	dampening bowls and brushers—Brown & Power	1 40

Agricultural Experiment Stations—Postage and Stationery—Continued.

10	rulers—Brown & Power	$0 65
4,250	Denison's tags—Brown & Power	2 90
36	balls twine—Brown & Power	1 80
6	bottles Carter's paste—Brown & Power	25
12	transfer cases—Brown & Power	2 80
½	gross Eagle pencils—Brown & Power	2 25
1	phono graphone—Pacific Phonograph Co.	60 00
17	blank cylinders—Pacific Phonograph Co.	5 00
	Postage stamps—John McCarthy, P. M.	54 00
84	sheets white paper—Blake, Moffitt & Towne	3 70
	Postage stamps—N. Sleppy, P. M.	4 00
2,000	sheets typewriting paper—Brown & Power	3 95
3	doz. long counter books—E. P. Bancroft	1 20
½	doz. weekly time books—E. P. Bancroft	72
1	doz. letter copying books—E. P. Bancroft	7 20
6	doz. copying blotters—E. P. Bancroft	36
6	doz. ordinary blotters—E. P. Bancroft	18
1	doz. desk blotters—E. P. Bancroft	20
1	rm. foolscap paper—E. P. Bancroft	1 15
7,000	letter heads—E. P. Bancroft	10 50
1,000	letter heads, ruled—E. P. Bancroft	1 70
1	box carbon paper—E. P. Bancroft	1 50
2	doz. tracing paper—E. P. Bancroft	30
5	doz. pads, 5x7½—E. P. Bancroft	2 00
5	doz. pads, 4x7—E. P. Bancroft	1 50
1,000	envelopes, white—E. P. Bancroft	1 60
1,000	envelopes, amber—E. P. Bancroft	1 60
2,000	envelopes, amber—E. P. Bancroft	2 00
4,000	envelopes, white—E. P. Bancroft	4 00
2	doz. oil boards—E. P. Bancroft	20
1½	doz. bank penholders—E. P. Bancroft	75
1,000	½″ paper fasteners, flat—E. P. Bancroft	75
500	assorted paper fasteners, flat—E. P. Bancroft	50
6	doz. cotton twine—E. P. Bancroft	1 80
1½	doz. pyramids pins—E. P. Bancroft	96
3	doz. thumb tacks—E. P. Bancroft	30
½	doz. India ink—E. P. Bancroft	1 13
1	doz. erasers, typewriter—E. P. Bancroft	30
1	doz. Franklin lumber crayon—E. P. Bancroft	30
2	doz. Hardmuth copy pencils, purple—E. P. Bancroft	60
½	gross pencils No. 3, rubber ends—E. P. Bancroft	1 00
1	gross pencils, ordinary—E. P. Bancroft	1 25
3	doz. pencils, red and blue—E. P. Bancroft	1 20
2	doz. note books—E. P. Bancroft	4 00
2,000	envelopes—E. P. Bancroft	4 50
		$306 00

APPENDIX No. 4 D—*Agricultural Experiment Stations—Freight and Expressage.*

Freightage—Southern Pacific Co.	$1 50
Expressage—Wells, Fargo & Co.	4 35
Freightage—Southern Pacific Co.	1 99
Expressage—Eagle Box Manufacturing Co.	25
Freightage—Southern Pacific Co.	10 34
Expressage—Wells, Fargo & Co.	29 15
Expressage—Wells, Fargo & Co.	23 45
Hauling freight—Isadore Le Duc	1 00
Freightage—Southern Pacific Co.	1 30
Freightage—Southern Pacific Co.	10 95
Freightage—Southern Pacific Co.	1 71
Freightage—Southern Pacific Co.	25
Freightage—Southern Pacific Co.	1 35
Freightage—Southern Pacific Co.	50
Freightage—Southern Pacific Co.	5 28
Freightage—Southern Pacific Co.	25
Freightage—Southern Pacific Co.	53
Freightage—Southern Pacific Co.	4 48
Freightage—Southern Pacific Co.	1 40
Expressage—Wells, Fargo & Co.	20 55
Expressage—Patterson & Co.	3 64
Freightage—Southern Pacific Co.	5 28
Freightage—Southern Pacific Co.	6 23
Expressage—Wells, Fargo & Co.	11 10
Freightage—Southern Pacific Co.	25

Agricultural Experiment Stations—Freight and Expressage—Continued.

Expressage—Wells, Fargo & Co.	$0 55
Freightage—Southern Pacific Co.	78
Freightage—Southern Pacific Co.	1 68
Expressage—Wells, Fargo & Co.	13 95
Expressage—Patterson & Co.	3 50
Freightage—Southern Pacific Co.	7 75
Freightage—E. Ginocchio & Bro.	5 23
Freightage—Southern Pacific Co.	1 09
Freightage—Southern Pacific Co.	1 88
Freightage—Southern Pacific Co.	50
Freightage—Southern Pacific Co.	25
Freightage—Southern Pacific Co.	2 25
Freightage—Southern Pacific Co.	25
Expressage—Wells, Fargo & Co.	75
Expressage—Wells, Fargo & Co.	35
Expressage—Wells, Fargo & Co.	55
Expressage—Wells, Fargo & Co.	33 57
Expressage—Patterson & Co.	1 50
Expressage—Wells, Fargo & Co.	40
Freightage—Southern Pacific Co.	32
Expressage—Whitney Transfer Co.	25
Expressage—Whitney Transfer Co.	25
Freightage—Southern Pacific Co.	2 45
Freightage—Southern Pacific Co.	25
Freightage—Southern Pacific Co.	2 02
Expressage—Wells, Fargo & Co.	25
Expressage—Wells, Fargo & Co.	35
Freightage—Southern Pacific Co.	35
Freightage—Southern Pacific Co.	25
Freightage—Southern Pacific Co.	25
Freightage—Southern Pacific Co.	25
Freightage—Piper, Aden, Goodall Co.	1 05
Freightage—R. Kny & Co.	25
Freightage—Southern Pacific Co.	99
Expressage—Wells, Fargo & Co.	45
Expressage—Whitney Transfer Co.	1 00
Expressage—Wells, Fargo & Co.	60
Expressage—Wells, Fargo & Co.	2 70
Freightage—Southern Pacific Co.	1 55
Freightage—Southern Pacific Co.	1 99
Expressage—Wells, Fargo & Co.	85
Expressage—Wells, Fargo & Co.	4 80
Expressage—Patterson & Co.	1 25
Expressage—Wells, Fargo & Co.	2 45
Freightage—Southern Pacific Co.	19
Freightage—Southern Pacific Co.	25
Freightage—Southern Pacific Co.	75
Freightage—Southern Pacific Co.	5 84
Freightage—Southern Pacific Co.	79
Freightage—Southern Pacific Co.	25
Freightage—Southern Pacific Co.	1 22
Expressage—Wells, Fargo & Co.	35
Expressage—Wells, Fargo & Co.	90
Freightage—Southern Pacific Co.	39
Freightage—Southern Pacific Co.	33
Freightage—Southern Pacific Co.	33
Freightage—Southern Pacific Co.	27
Freightage—Southern Pacific Co.	25
Expressage—Wells, Fargo & Co.	25
Expressage—Patterson & Co.	25
Expressage—Wells, Fargo & Co.	2 00
Expressage—Wells, Fargo & Co.	95
Expressage—Wells, Fargo & Co.	40
Expressage—Wells, Fargo & Co.	10 87
Expressage—Patterson & Co.	2 00
Expressage—Wells, Fargo & Co.	1 45
Expressage—Wells, Fargo & Co.	1 25
Freightage—Southern Pacific Co.	47
Freightage—Southern Pacific Co.	25
Expressage—Southern Pacific Co.	1 60
Freightage—Southern Pacific Co.	2 19
Freightage—Southern Pacific Co.	5 47
Expressage—Wells, Fargo & Co.	3 90
Expressage—Wells, Fargo & Co.	2 93

Agricultural Experiment Stations—Freight and Expressage—Continued.

Freightage—Southern Pacific Co.	$5 19
Expressage—Patterson & Co.	15 36
Freightage—Southern Pacific Co.	61
Freightage—Southern Pacific Co.	37 06
Freightage—B. Kahn & Son	1 25
	$358 84

Appendix No. 4 E—*Agricultural Experiment Stations—Heat, Light, and Water.*

1 8″ brass bushing—Knight & Co.	$10 00
Repairs to pump—Knight & Co.	50
4 leather cups—Woodin & Little	2 12
12 cases Pearl oil—Standard Oil Co.	24 00
3 cases coal oil—E. Ginocchio & Bro.	7 95
21½ ft. 2″ pipe—Ira F. White & Son	1 29
Cutting pipe—Ira F. White & Son	25
1 ¾″ garden valve—Ira F. White & Son	50
2 ¾″ fittings—Ira F. White & Son	16
Repairs to water tank—Ira F. White & Son	25
1 gird pipe and plumbing—A. Palm	5 00
12 ft. 3″ pipe—J. C. Murray	1 00
12 ft. ¾″ pipe—J. C. Murray	75
1 ¾″ union—J. C. Murray	20
5 hours' labor—J. C. Murray	2 50
1 sprinkler—J. C. Murray & Bro.	3 00
1 3″ tee—J. C. Murray & Bro.	1 00
1 3″ plug—J. C. Murray & Bro.	75
1 3″ nipple—J. C. Murray & Bro.	1 00
1 piece 3″ pipe—J. C. Murray & Bro.	50
Wire and leather—J. C. Murray & Bro.	20
Labor—J. C. Murray & Bro.	5 00
Repairs to sprinkler—J. C. Murray & Bro.	1 00
1 spray nozzle—Ira F. White & Son	40
1 brass reducer—Ira F. White & Son	25
1⅓ ft. ¾″ iron pipe—Ira F. White & Son	06
4 ¾″ fittings—Ira F. White & Son	32
1¾ lbs. lead pipe—Ira F. White & Son	14
3½ hours' labor—Ira F. White & Son	1 40
6 rubber washers—Ira F. White & Son	05
3 sink washers—Ira F. White & Son	10
3 tons coal, Pomona Station—Hoffman & Ulery	27 00
15 cases kerosene oil—Standard Oil Co.	29 25
	$127 89

Appendix No. 4 F—*Agricultural Experiment Stations—Chemical Supplies.*

2 carboys—J. Caire Co.	$4 50
120 lbs. hydrochloric acid—J. Caire Co.	3 60
142 lbs. nitric acid—J. Caire Co.	9 23
1 bottle chlorinated soda—Redington & Co.	35
2 lbs. carbonate of soda—John Taylor & Co.	90
4 doz. Erlemeyer flasks—John Taylor & Co.	5 50
1 lb. copper sulphate—John Taylor & Co.	35
8 gross wide-mouthed bottles—John Taylor & Co.	28 50
2 graduated pipettes—John Taylor & Co.	30
2 rms. filter paper—J. Caire Co.	17 00
6 ozs. iodine—J. Caire Co.	1 80
10 ft. platinum wire—J. Caire Co.	9 46
2 doz. Erlemeyer flasks, 6-oz.—J. Caire Co.	4 00
2 doz. Erlemeyer flasks, 3-oz.—J. Caire Co.	3 00
1 Bunsen burner—J. Caire Co.	2 25
2 bottles sulph. ether—J. Caire Co.	5 11
2½ ozs. methyl orange—Eberback Drug Co.	1 00
1 lb. molyb. acid—John Taylor & Co.	2 00
6 graduated pipettes—John Taylor & Co.	54
6 tube swabs—John Taylor & Co.	48
1 glass mortar pestle—John Taylor & Co.	25
6 iron stands with rings—John Taylor & Co.	2 70
1 lb. potass. permanganate—John Taylor & Co.	30
1 lb. soda hydrate—John Taylor & Co.	45
5 lbs. lead acetate—John Taylor & Co.	75
9 lbs. sulph. acid—J. Caire Co.	2 25
4 glass funnels—J. Caire Co.	33
1 lb. Rochells—J. Caire Co.	85

Agricultural Experiment Stations—Chemical Supplies—Continued.

3½ lbs. ether sulph.—J. Caire Co.	$2 80
4 gross velvet corks—J. Caire Co.	1 00
3½ lbs. sulphuric ether—J. Caire Co.	2 63
9 lbs. sulphuric ether, C. P.—J. Caire Co.	2 25
24 ft. ¼ special I. R. tubing—H. Heil Chemical Co.	1 92
24 ft. 5/16 special I. R. tubing—H. Heil Chemical Co.	2 40
3½ lbs. sulphuric ether—J. Caire Co.	2 63
20 lbs. greenbark potash—J. Caire Co.	2 50
2 graduated pipettes	24
3 F. 3 flasks, 1½-gal.—J. Caire Co.	2 82
1 gal. boiled linseed oil—J. Caire Co.	80
6 sq. ft. copper, 16-oz.—J. Caire Co.	1 86
3½ lbs. sulphuric ether—J. Caire Co.	2 63
1 lb. potass. sulphate, C. P.—J. Caire Co.	22
1 lb. potass. sulphide, C. P.—J. Caire Co.	30
6 oxygen flasks, 1½-pt.—J. Caire Co.	13 50
6 straw rings, 8″ dia. to 5″ dia.—J. Caire Co.	1 90
1 doz. small flasks, short neck—J. Caire Co.	1 68
1 doz. small flasks, short neck—J. Caire Co.	1 32
	$153 15

APPENDIX NO. 4 G—*Agricultural Experiment Stations—Seeds, Plants, and Sundry Supplies.*

500 tree labels—Sunset Seed and Plant Co.	$0 50
200 grape baskets—Eagle Box Mfg. Co.	2 00
1 whip—J. R. McCain	50
Repairs to harness—J. R. McCain	2 15
Repairs to halter—J. R. McCain	30
4 shoes—Davis & Nissen	1 50
14 shoes—W. C. Henderson	5 25
1 bbl. lime—W. H. Tyson	1 55
1 box shells—Ira F. White & Son	50
60 lbs. nails, assorted—Ira F. White & Son	3 00
¼ gal. varnish—Ira F. White & Son	90
2 horse chains—Lewis & Hardie	90
3 pkgs. seeds—Henry A. Dreer	1 00
16 grape crates and baskets—F. Schwan & Son	2 40
10 peach boxes—F. Schwan & Son	60
25 lbs. Portland cement—L. Fleming	25
Plants—Carl Purdy	1 00
12 assorted plants—Schlegel & Fottler	1 00
8 assorted plants—W. S. Lyon & Co.	6 50
3 cans paint—E. Ginocchio & Bro.	75
14 plants—Southern California Acclimatizing Ass'n	12 00
62 plants—Southern California Acclimatizing Ass'n	38 00
1 can axle grease—Lewis & Hardie	15
1 case coal oil—Lewis & Hardie	2 75
Harness oil—Lewis & Hardie	1 00
Harness soap—Lewis & Hardie	25
1 saddle—J. C. Johnson & Co.	9 50
20 lbs. wheat—E. Ginocchio & Bro.	25
3 lbs. sugar—E. Ginocchio & Bro.	20
Gum arabic—E. Ginocchio & Bro.	15
1 1½″ tee—E. Ginocchio & Bro.	15
1 catch and butts—E. Ginocchio & Bro.	50
2 cans umber—E. Ginocchio & Bro.	50
Litharge—Marshall & Androus	25
9½ lbs. Manila rope—Lewis & Hardie	1 35
3 lbs. putty—Lewis & Hardie	15
15 shoes—Garbarini Bros.	7 25
Shoeing two horses—A. Young	2 50
1 wagon-cover—Neville & Co.	5 45
54 assorted plants—Theodosia B. Shepherd	31 55
1 Seaforthia elegans—Sunset Seed & Plant Co.	15 00
1 Wickson plum tree—Luther Burbank	1 00
1 Giant plum tree—Luther Burbank	1 00
100 New Hybrid plums—Luther Burbank	3 00
12 Prunus tomentosa—Luther Burbank	1 50
400 scions of fruits—Luther Burbank	9 30
24 scions of berries—Luther Burbank	6 00
2 Pennesetum ruppellianum—Luther Burbank	50
4 smilax—Luther Burbank	1 00
12 clematis—Luther Burbank	1 50
4 ozs. verbena seed—Luther Burbank	1 00

Agricultural Experiment Stations—Seeds, Plants, and Sundry Supplies—Continued.

1 oz. verbena seed—Luther Burbank	$0 20
14 pkgs. seeds—L. L. May & Co.	1 55
7 pkgs. seeds—W. H. Maule	1 50
Squirrel poison—Lewis & Hardie	2 00
2,000 wired labels—Trumbull & Beebe	2 00
4 lbs. bluegrass seed—Trumbull & Beebe	1 00
1 splendoe, selected—Leonard Coates	1 50
10½ lbs. sugar of lead—Pierce & Robbins	80
Bisulph. carbon—Pierce & Robbins	20
1 strainer—Ira F. White & Son	25
1 spring balance—Ira F. White & Son	40
1 padlock—Ira F. White & Son	25
6 yds. fringe—Phil. Stein Co.	1 60
23 assorted scions—Pomona Nurseries	1 75
100 pkgs. seeds—Chas. Schwake	1 50
11 ozs. seeds—J. M. Thorburn & Co.	97
16⅔ lbs. wire nails—J. Goldman & Co.	1 00
28 peach trees—G. L. Taber	3 45
24 apple trees—Oregon Nurseries	1 80
27 assorted trees—Oregon Nurseries	4 02
100 coin sacks—Neville & Co.	2 50
25 pkgs. seeds—Germain Fruit Co.	2 00
1 Juglans cordiformis—H. H. Berger & Co.	35
12 pkgs. seeds—T. B. Shepherd	1 65
1 sprinkler—Germain Fruit Co.	1 75
3 pkgs. seeds—Germain Fruit Co.	65
2 pr. shears—Peter Henderson & Co.	2 25
1 pruning knife—Peter Henderson & Co.	90
1 pencil—Peter Henderson & Co.	05
1 pr. malleable shears—Peter Henderson & Co.	75
3 pkgs. seeds—J. L. Childs	50
17 pkgs. seeds—W. A. Burpee & Co.	1 75
13 assorted plants—Leonard Coates	3 45
75 lbs. salt—J. W. Mills	75
3 boxes shells—Ira F. White & Son	1 50
1 lantern globe—Ira F. White & Son	15
15 pkgs. seeds—D. Landreth & Sons	1 86
1,000 coin envelopes—Bonestell & Co.	70
16 scions—Rogers Nursery Co.	1 00
3 trees—Trumbull & Beebe	1 00
2,000 wood labels—Sunset Seed & Plant Co.	4 45
9 trees—East Whittier Nurseries	4 25
3 trees—R. Kny & Co.	2 70
1 case—R. Kny & Co.	30
100 seed pans—Oakland Art Pottery Works	15 00
1,000 soil bags—California Awning Co.	12 50
3 gooseberry seedlings—Sunset Seed & Plant Co.	1 10
4 raspberry seedlings—Sunset Seed & Plant Co.	1 20
7 small trees—Storrs & Harrison Co.	2 20
2,000 pot labels—H. M. Sanborn	1 60
Copper wire—H. M. Sanborn	50
7 pkgs. seeds—H. H. Berger & Co.	4 25
750 pear seedlings—Trumbull & Beebe	3 75
250 pear seedlings—Trumbull & Beebe	1 25
250 plum seedlings—Trumbull & Beebe	1 25
200 plum seedlings—Trumbull & Beebe	1 00
200 pear seedlings—Trumbull & Beebe	1 00
10 grapevines—Trumbull & Beebe	1 45
250 pear seedlings—Trumbull & Beebe	1 25
18 assorted seedlings—Trumbull & Beebe	3 20
1 lb. sunflower seed—Trumbull & Beebe	25
250 plum seedlings—Trumbull & Beebe	1 25
250 pear seedlings—Trumbull & Beebe	1 25
100 cherry seedlings—Trumbull & Beebe	1 00
100 assorted scions—Stark Bros. Co.	4 05
5 lbs. blue grass—Trumbull & Beebe	1 00
6 shoes—Garbarini Bros.	2 50
10 shoes—W. C. Henderson	3 75
100 peach trees—California Nursery Co.	8 00
3 apricot trees—California Nursery Co.	75
1 apricot tree—California Nursery Co.	40
1 prune tree—California Nursery Co.	25
3 nectarine trees—California Nursery Co.	75
6 plum trees—California Nursery Co.	2 10

Agricultural Experiment Stations—Seeds, Plants, and Sundry Supplies—Continued.

3 chestnut trees—California Nursery Co.	$1 50
3 orange trees—California Nursery Co.	3 00
270 assorted scions—Hoopes Bros. & Thomas	4 59
1½ lbs. assorted seeds—J. M. Thorburn & Co.	30
10 assorted trees—Stark Bros.	1 50
400 painted labels—Sunset Seed & Plant Co.	3 00
Signs—Storrs & Harrison Co.	50
50 peach trees—California Nursery Co.	3 25
1 plum tree—Stark Bros.	1 10
5 peach trees—Stark Bros.	1 45
5 scions—Stark Bros.	50
Shoeing 2 horses—A. Young	2 50
10 pkgs. seeds—Wm. H. Maule	1 50
9 assorted trees—Silas Wilson Co.	3 75
100 pear seedlings—H. H. Berger & Co.	2 00
9 assorted trees—H. H. Berger & Co.	1 30
17½ ozs. seeds—H. H. Berger & Co.	1 05
2 roots—H. H. Berger & Co.	20
1 pkg. assorted scions—Albertson & Hobbs	1 00
25 scions—Phœnix Nursery Co.	58
6 apple and plum trees—Geo. Ruedy	3 00
11 assorted trees—John Lewis Childs	3 45
4,000 wired labels—Trumbull & Beebe	4 00
19 varieties apple scions—Ellwanger & Barry	4 75
8 shoes—T. R. Davis	3 00
40 lbs. grass seed—Germain Fruit Co.	5 00
80 grafts—John Saul	90
6 plum and goosberry trees—Silas Wilson Co.	1 75
36 assorted scions—Wm. Purry	1 35
2 harness straps—A. F. Pruess	35
2 cinch straps—E. G. Freeman	50
1 gal. cylinder oil—J. Goldman & Co.	1 00
4 lbs. grass seed—Trumbull & Beebe	1 00
Hose funnel—Ira F. White & Son	45
11½ ft. screen wire—Ira F. White & Son	25
1 paper tacks—Ira F. White & Son	05
1,000 pot labels—Trumbull & Beebe	1 50
4 lbs. grass seed—Trumbull & Beebe	1 00
2 turragon roots—J. M. Thorburn & Co.	60
1 collection ricinus, 12 varieties—J. M. Thorburn & Co.	50
1½ doz. garden pencils—J. M. Thorburn & Co.	1 80
200 seedling apples—California Nursery Co.	2 20
4 agricultural calendars—John Wiley & Sons	3 39
37 assorted plants—H. H. Berger & Co.	4 85
4 assorted plants—Geo. Ruedy	2 85
10 varieties pear scions—Ellwanger & Barry	4 00
23 varieties pear scions—Ellwanger & Barry	2 75
50 peach plants—California Nursery Co.	3 00
4 goosberries—C. H. Josten	4 00
Stove polish—Lewis & Hardie	10
Turpentine—Lewis & Hardie	20
Sapolio—Lewis & Hardie	25
12 shoes—W. C. Henderson	4 50
13 shoes—Garbarini Bros.	5 50
16 pkgs. seed—Barr & Son	2 88
1 pkg. scions—Morris, Stone & Wellington	1 00
108 apple grafts—John Saul	1 08
6 pear grafts—John Saul	15
6 pynes maulis—John Saul	15
16½ lbs. galv. wire—Linder Hardware Co.	1 32
5 lbs. barbed wire—Linder Hardware Co.	25
1 Hunter lifter—Gallagher Bros.	25
1½ yds. rubber tubing—Pierce & Robbins	30
Shutoff and cork—Pierce & Robbins	15
Vitriol—Pierce & Robbins	1 35
1,500 patent tule tree protectors—B. F. Gilman	9 13
1,500 apple seedlings—California Nursery Co.	15 00
50 quince, Angers—California Nursery Co.	1 00
20 Normandy cider apples—California Nursery Co.	10 00
2,000 apple seedlings, French Crab—California Nursery Co.	20 00
100 apple seedlings, Doncin—California Nursery Co.	2 00
200 apple seedlings, Paradise—California Nursery Co.	4 00
200 Myrobalan seedlings—California Nursery Co.	2 00
150 Mazzard seedlings—California Nursery Co.	3 00

Agricultural Experiment Stations—Seeds, Plants, and Sundry Supplies—Continued.

100 Mahaleb seedlings—California Nursery Co.	$2 00
500 pear seedlings—California Nursery Co.	5 00
1,000 apple seedlings—California Nursery Co.	10 00
200 Myrobalan seedlings—California Nursery Co.	2 00
150 Mazzard seedlings—California Nursery Co.	3 00
100 Mahaleb seedlings—California Nursery Co.	2 00
50 quince seedlings—California Nursery Co.	1 00
10 new pear seedlings—California Nursery Co.	5 00
1 plum, Bell de Pontoic—California Nursery Co.	50
4 new apples—California Nursery Co.	2 00
1 pear, Victor Hugo—California Nursery Co.	50
50 quince, Angers—California Nursery Co.	1 00
10 new pear—California Nursery Co.	5 00
1 plum, Belle de Pontoic—California Nursery Co.	50
4 new apple—California Nursery Co.	2 00
1 pear, Victor Hugo—California Nursery Co.	50
160 berry plants—L. L. Watkins	4 00
3⅓ lbs. raffia—Trumbull & Beebe	75
2 boxes crayons—H. D. Eliason	1 00
2 cans glue—H. D. Eliason	1 20
1 thermometer—H. D. Eliason	25
5 gopher traps—Lewis & Hardie	1 00
11 gals. oil—Lewis & Hardie	50
2 paint brushes—Lewis & Hardie	35
1 ball mat twine—Lewis & Hardie	25
300 flower pots—Lewis & Hardie	4 50
Cement—Lewis & Hardie	25
Hook and eye—Lewis & Hardie	20
Hame, straps, and tugs—E. G. Freeman	2 50
Enameled ducking—Iowa Agricultural College	20
12 plum trees—Iowa Agricultural College	1 44
6 shrubs—Iowa Agricultural College	60
Packing—Iowa Agricultural College	25
40 apple trees—Iowa Agricultural College	4 00
20 apple trees—Iowa Agricultural College	2 00
18 cherry trees—Iowa Agricultural College	2 16
4 shoes—Garbarini Bros.	2 50
1 single harness—S. N. Pelton	18 00
1 reel-twisted fence wire—Cal. Wire Cloth Co.	2 80
Galvanized staples—Cal. Wire Cloth Co.	15
2 bottles harness oil—S. Taylor	55
4 cans axle grease—S. Taylor	50
1 sponge—S. Taylor	35
1 horse brush—S. Taylor	25
100 ft. surfaced redwood work—H. Taylor	2 50
1 gal. boiled oil—L. Wakeham	65
	$613 02

APPENDIX No. 4 H—*Agricultural Experiment Stations—Fertilizers.*

10 gals. crude oil—A. G. Forbeer	$0 75
2,500 lbs. bone phosphate—California Fertilizer Works	35 00
2 bbls. lime—Kerckhoff-Cuzner M. & L. Co.	3 60
200 lbs. sulphur—Kerckhoff-Cuzner M. & L. Co.	4 50
50 lbs. bluestone—Kerckhoff-Cuzner M. & L. Co.	3 50
1 vinegar barrel—Poston & Hamlin	1 25
Water, July to December, inclusive—Blue Lakes Water Co.	6 00
¼ ton superphosphate—California Fertilizer Co.	7 85
880 lbs. superphosphate—Dempteer & Son	18 84
15 tons gypsum—Paoli Gypsum Co.	120 00
25 ft. ½″ 3-ply Double Diamond hose—N. Y. Belting & Pkg. Co.	2 50
50 ft. ¾″ 3-ply Double Diamond hose—N. Y. Belting & Pkg. Co.	6 00
100 ft. 1″ 3-ply Double Diamond hose—N. Y. Belting & Pkg. Co.	16 00
9 doz. ¾″ hose washers—N. Y. Belting & Pkg. Co.	45
8 doz. 1″ hose washers—N. Y. Belting & Pkg. Co.	50
75 ft. ¾″ 3-ply Double Diamond hose—N. Y. Belting & Pkg. Co.	9 00
25 ft. ½″ 3-ply Double Diamond hose—N. Y. Belting & Pkg. Co.	2 50
1 doz. ¾″ hose washers—N. Y. Belting & Pkg. Co.	05
1 doz. 1″ hose washers—N. Y. Belting & Pkg. Co.	06
75 ft. ¾″ Double Diamond hose—N. Y. Belting & Pkg. Co.	9 00
25 ft. ½″ Double Diamond hose—N. Y. Belting & Pkg. Co.	2 50
1 doz. ¾″ hose washers—N. Y. Belting & Pkg. Co.	05
1 doz. 1″ hose washers—N. Y. Belting & Pkg. Co.	06
50 ft. 1″ 3-ply Double Diamond hose—N. Y. Belting & Pkg. Co.	8 00
1 doz. 1″ hose washers—N. Y. Belting & Pkg. Co.	07

Agricultural Experiment Stations—Fertilizers—Continued.

50 ft. ¾″ 3-ply Double Diamond hose—N. Y. Belting & Pkg. Co.	$6 00
25 ft. ½″ 3-ply Double Diamond hose—N. Y. Belting & Pkg. Co.	2 50
10 ft. 3″ 4-ply Carbon hose—N. Y. Belting & Pkg. Co.	7 00
1 doz. ¾″ hose washers—N. Y. Belting & Pkg. Co.	05
1 doz. 1″ hose washers—N. Y. Belting & Pkg. Co.	06
6 Wirts hose reels—N. Y. Belting & Pkg. Co.	15 00
	$288 64

APPENDIX No. 4 I—*Agricultural Experiment Stations—Feeding-Stuffs.*

2,000 lbs. rolled barley—M. A. Rodgers	$18 00
4 loads straw—Thos. Turner	4 50
180 lbs. seed barley—Julius Forrer	3 60
2,500 lbs. ground barley—E. Ginocchio & Bro.	23 75
3,000 lbs. seed barley—E. Ginocchio & Bro.	26 25
7 tons hay—W. H. Tyson	49 00
7,000 lbs. barley—H. Petersen	35 00
1,000 lbs. wheat—H. Petersen	11 00
Rolling 1,665 lbs. barley—Sperry Flour Co.	1 00
1,000 lbs. seed barley—E. Ginocchio & Bro.	9 00
50 lbs. rock salt—E. Ginocchio & Bro.	60
Rolling barley—Sperry Flour Co.	1 25
1,000 lbs. barley—Lorberer & Carter	7 00
2,000 lbs. rolled barley—Lorberer & Carter	15 00
600 lbs. seed barley—James Estes	6 00
Rolling 1,920 lbs. barley—Sperry Flour Co.	1 45
4,220 lbs. hay—John Belluomini & Co.	31 65
533 lbs. barley—Paine & Lee	4 00
800 lbs. hay—E. Ginocchio & Bro.	5 60
	$253 65

APPENDIX No. 4 J—*Agricultural Experiment Stations—Library.*

1 Manual of Forestry, vol. 1—B. Whidden	$3 00
1 Manual of Forestry, vol. 2—B. Whidden	4 20
1 Johnson's How Grapes Grow—Students, Coöp. Ass'n	1 45
1 Manual of Forestry, vol. 3—Bradlee Whidden	4 20
2 copies Expt. Station Reports, 1885—W. A. Henry	2 00
1 copy Handbook of Plants—Peter Henderson	2 20
2 diaries—John Wiley & Sons	1 69
4 maps—Brown & Power	2 40
1 Aschen Analysen—Hicks-Judd Co.	1 35
	$22 49

APPENDIX No. 4 K—*Agricultural Experiment Stations—Tools, Implements, and Machinery.*

8 clamps—Davis & Nissen	$3 30
Setting tire—Davis & Nissen	75
Bolts—Davis & Nissen	25
Repairs to wagon—Davis & Nissen	50
Hinges—W. C. Henderson	2 00
Bolts and screws—W. C. Henderson	25
Band iron and bolts—W. C. Henderson	65
Bolt—W. C. Henderson	10
1 tire set—W. C. Henderson	1 00
Repairing dasher—W. C. Henderson	50
Repairing spring—W. C. Henderson	1 50
1 7-ft. orchard ladder—Ira F. White & Son	2 10
1 pr. hedge shears—Ira F. White & Son	1 50
2 doz. bolts—Ira F. White & Son	50
Repairing harrow—F. L. Lewis	25
1 cultivator handle—Phil Stein Co.	40
1 cultivator shovel—George Weimar	40
1 harness punch—M. Everson	1 00
1 ax—E. Ginocchio & Bro.	1 25
3 paint brushes—E. Ginocchio & Bro.	1 75
1 walking-beam for pump—A. Palm	25 00
Repairing wagon—W. C. Henderson	10 00
1 Maydole hammer—Lewis & Hardie	75
1 hatchet—Lewis & Hardie	75
1 ax—Lewis & Hardie	1 25
4 cans wagon paint—Lewis & Hardie	4 00
1 No. 20 Oliver plow—Lewis & Hardie	11 50
1 pick and handle—Ira F. White & Son	85

Agricultural Experiment Stations—Tools, Implements, and Machinery—Continued.

1 crowbar—Ira F. White & Son	$1 30
5 lbs. steel wedges—Ira F. White & Son	50
1 plow wheel—Lewis & Hardie	1 50
2 plowshares—Lewis & Hardie	1 50
4 plow slips—Lewis & Hardie	1 00
6 bolts—Garbarini Bros.	50
2 brake blocks—Garbarini Bros.	1 00
Repairing brake bar—Garbarini Bros.	50
3 plows pointed—A. Young	2 50
1 spray pump—Phil Stein Co.	30 00
30 ft. hose—Phil Stein Co.	6 00
1 ⅝" bit—Lewis & Hardie	50
2 files—Lewis & Hardie	25
½ lb. copper rivets—Lewis & Hardie	20
1 plowshare—Lewis & Hardie	75
10 rear colters for harrow—Baker & Hamilton	4 00
10 front colters for harrow—Baker & Hamilton	3 60
2 grafting knives—J. Caire Co.	1 00
1 Knapp standard—Hooker & Co.	2 33
1 Knapp share—Hooker & Co.	2 32
1 screw wrench—E. Ginocchio & Bro.	1 75
2 trowels—Pierce Hardware Co.	1 00
1 pruning knife—Pierce Hardware Co.	1 00
1 Benicia share—Baker & Hamilton	3 00
1 Star share—Baker & Hamilton	1 69
1 Star landslide—Baker & Hamilton	93
1 pr. pruning shears—R. & A. Glinka	1 50
Setting 1 tire—Garbarini Bros.	1 00
1 spoke—Garbarini Bros.	35
1 bolt—Garbarini Bros.	15
6 harrow teeth—Garbarini Bros.	75
1 steel on pick—Garbarini Bros.	75
12 bolts—W. C. Henderson	75
1 spring shackle—W. C. Henderson	75
2 rods and repairs—W. C. Henderson	1 50
Sharpening harrow teeth—W. C. Henderson	50
2 rings on mold—A. Young	60
2 plows sharpened—A. Young	60
1 Star share—Baker & Hamilton	1 69
1 Star landslide—Baker & Hamilton	93
6 Bradley shares—Hooker & Co.	2 17
2 bolts—R. T. Davis	20
1 pick sharpened—R. T. Davis	25
Repairing buggy—R. T. Davis	1 75
1 T bolt—R. T. Davis	25
Repairing buggy—R. T. Davis	25
Setting axle—R. T. Davis	2 00
2 bolts—R. T. Davis	25
Mending brace—R. T. Davis	50
1 garden cultivator—H. Allison	3 00
1 Deal Victor wagon—Baker & Hamilton	70 00
1 hoe—Ira F. White & Son	30
1 shovel—Ira F. White & Son	55
1 shovel—Ira F. White & Son	1 25
8 bolts—Ira F. White & Son	28
Repairing wagon—W. C. Henderson	2 25
6 harrow teeth—Garbarini Bros.	1 70
1 saw filed—Garbarini Bros.	1 00
Steel on mattock—Garbarini Bros.	75
1 beet cultivator—Phil Stein Co.	18 00
1 cold chisel—Linder Hardware Co.	25
25 ft. hose—A. Erlandsen	3 90
1 padlock—A. Erlandsen	50
1 saw frame—A. Erlandsen	40
2 shovels—A. Erlandsen	1 80
Fittings and threading—A. Erlandsen	1 15
2 steel rakes—A. Erlandsen	1 10
2 copper wire—A. Erlandsen	70
Sharpening scissors—A. Erlandsen	40
1 Kelly ax—E. R. Tutt	1 25
1 hammer—E. R. Tutt	65
2 tack hammers—E. R. Tutt	60
4 trowels—E. R. Tutt	1 00
1 set garden tools—E. R. Tutt	90

Agricultural Experiment Stations—Tools, Implements, and Machinery—Continued.

1 crowbar—Garbarini Bros.	$3 25
2 hatchets—E. R. Tutt	1 50
2 trowels—E. R. Tutt	1 00
2 garden forks—E. R. Tutt	50
2 garden forks—E. R. Tutt	30
2 garden forks—E. R. Tutt	20
1 spade—E. R. Tutt	50
1 ax, 2 handles—Ginocchio Bros.	1 90
2 files—Lewis & Hardie	35
Sharpening harrow teeth—Henderson Wagon Works	50
Repairing plow—Garbarini Bros.	25
1 log-rod—Garbarini Bros.	1 50
Clip on cart shaft—Garbarini Bros.	50
Cart shaft hinges—Garbarini Bros.	1 00
Repairs to buggy—Geo. Weimar	4 25
Repairs to cultivator—Geo. Weimar	5 25
4 grape hooks—J. Caire Co.	1 00
1 pruning knife—J. Caire Co.	1 00
1 wagon pole—Phil Stein Co.	8 00
	$310 54

APPENDIX NO. 4 L—*Agricultural Experiment Stations—Furniture and Fixtures.*

28 yds. linoleum—E. Ginocchio & Bro.	$34 00

APPENDIX NO. 4 M—*Agricultural Experiment Stations—Scientific Apparatus.*

1 pocket thermometer—J. Caire Co.	$0 75
6 soil thermometers—Henry J. Green	37 13
Repairing 2 thermometers—Pacific Optical Co.	50
8 square covers—C. C. Reidy	1 30
1 dissecting forceps—C. C. Reidy	50
6 capped bottles—C. C. Reidy	1 55
48 watch glasses—C. C. Reidy	3 00
8 standards—C. C. Reidy	3 00
8 round covers—C. C. Reidy	2 70
1 dissecting scissors—C. C. Reidy	65
12 needle holders—C. C. Reidy	60
3 Richards thermographs—B. Kahn & Son	112 50
1 Empire State camera—H. Kahn & Co.	16 20
1 tripod—H. Kahn & Co.	2 25
1 Velox lens, ⅝—H. Kahn & Co.	10 00
1 extra plate-holder—H. Kahn & Co.	1 20
3 papier maché trays, ⅝—H. Kahn & Co.	1 25
2 kits, ⅘—H. Kahn & Co.	50
1 printing frame, ⅝—H. Kahn & Co.	50
1 printing frame ⅘—H. Kahn & Co.	35
1 cloth—H. Kahn & Co.	50
7 doz. Leed "D" plates, ⅝—H. Kahn & Co.	7 00
	$203 93

APPENDIX NO. 4 N—*Agricultural Experiment Stations—Traveling.*

Traveling expenses—E. W. Hilgard	$80 00
E. W. Hilgard	37 25
C. H. Shinn	8 25
C. H. Shinn	10 25
F. T. Bioletti	21 30
C. W. Woodworth	12 00
Geo. Hansen	17 10
Geo. Hansen	20 05
F. T. Bioletti	8 60
F. T. Bioletti	3 80
A. P. Hayne	31 70
E. W. Hilgard	11 00
C. W. Woodworth	6 50
C. W. Woodworth	3 90
A. P. Hayne	3 70
A. P. Hayne	5 60
A. P. Hayne	6 20
C. H. Shinn	46 35
C. H. Shinn	4 50
A. V. Stubenrauch	18 70
C. H. Shinn	18 45
W. H. Tyson	3 25

Agricultural Experiment Stations—Traveling—Continued.

Traveling expenses—F. T. Bioletti	$3 40
C. H. Shinn	10 10
J. W. Mills	2 55
F. T. Bioletti	8 00
One 3,000-mile railroad ticket—Southern Pacific Company	75 00
Traveling expenses—C. W. Woodworth	17 45
A. P. Hayne	20 35
J. W. Mills	1 00
C. W. Woodworth	55 15
A. P. Hayne	18 00
E. W. Hilgard	22 05
C. H. Shinn	13 85
A. V. Stubenrauch	22 95
C. H. Shinn	23 25
C. H. Shinn	4 75
C. W. Woodworth	1 70
C. H. Shinn	37 85
Wm. Winterhalter	90
J. Burt Davy	34 38
C. W. Woodworth	23 85
	$774 98

APPENDIX NO. 4 O—*Agricultural Experiment Stations—Contingent Expenses.*

Feeding horse—R. H. Humphrey	$0 50
35 copies Morning Call—W. C. Mason	1 00
Veterinary services—P. P. Parent	2 00
Veterinary services—W. J. Fleming	15 00
Annual dues—Association of American Agricultural Colleges and Experiment Stations	20 00
3 views of Amador Station—O. H. Reichling	4 75
1 ribbon stamp—Brown & Power	50
	$43 75

APPENDIX NO. 4 P—*Agricultural Experiment Stations—Buildings and Repairs.*

400 ft. Oregon pine—Kerckhoff-Cuzner M. & L. Co.	$8 40
95 ft. redwood—Kerckhoff-Cuzner M. & L. Co.	2 65
1 bbl. cement—Kerckhoff-Cuzner M. & L. Co.	3 75
1 iron washstand and connections—W. H. Tyson	7 50
Repairing plastering—J. W. Hutchinson	2 50
500 ft. spruce and pine lumber—F. M. Whitmore	10 00
200 shakes—F. M. Whitmore	2 00
1,000 ft. redwood boards—Salinas Valley Lumber Co.	23 50
96 ft. Oregon pine—Salinas Valley Lumber Co.	2 44
64 ft. Oregon plank—Salinas Valley Lumber Co.	2 56
100 ft. scantling—Salinas Valley Lumber Co.	2 25
1 lock and staples—Lewis & Hardie	50
1 lock—Lewis & Hardie	50
25 lbs. nails—Lewis & Hardie	1 50
5 gals. linseed oil—Lewis & Hardie	3 75
96 ft. redwood—Salinas Valley Lumber Co.	2 25
186 ft. lumber—F. M. Whitmore	3 80
15 ft. lumber, T. & G.—F. M. Whitmore	52
50 shakes—F. M. Whitmore	50
6 ft. rustic—Salinas Valley Lumber Co.	20
1 window—Salinas Valley Lumber Co.	1 40
4 lights glass—Lewis & Hardie	3 15
24 ft. redwood—Salinas Valley Lumber Co.	56
Cleaning sewer pipe—A. Palm	2 00
Repairing faucets—A. Palm	2 00
60 lbs. nails—E. Ginocchio & Bro.	3 00
87 ft. lumber—Pacific Lumber Co.	2 30
242 ft. lumber—Pacific Lumber Co.	3 00
10 pkgs. calcimine—Lewis & Hardie	6 50
2½ gals. oil finish—Lewis & Hardie	5 00
1 wall brush—Lewis & Hardie	90
1 qt. turpentine—Lewis & Hardie	20
1 wash brush—Lewis & Hardie	50
1 lb. lampblack—Lewis & Hardie	25
1 lb. Manilla rope—Lewis & Hardie	15
1 walnut mantel—Bush & Mallett Co.	12 50
85 ft. redwood—Puget Sound Lumber Co.	2 13
Carriage paint—Marshall & Androus	2 85
258 ft. lumber—Pacific Lumber Co.	4 05

Agricultural Experiment Stations—Buildings and Repairs—Continued.

40 ft. 2″ cast-iron pipe—E. C. Cottier	$6 40
1 2″ cast-iron elbow—E. C. Cottier	60
6 2″ cast-iron fittings—E. C. Cottier	2 10
3 brass ferrules for lead pipe connections—E. C. Cottier	85
1 cast-iron hub—E. C. Cottier	35
3 lead "T" traps—E. C. Cottier	2 50
30 lbs. 1½″ lead pipe—E. C. Cottier	3 00
20 lbs. lead (solder)—E. C. Cottier	1 70
3 lbs. oakum—E. C. Cottier	50
80 ft. galv. sheet-iron pipe—E. C. Cottier	8 00
Pipe and fittings for water back—E. C. Cottier	1 50
1 sink—E. C. Cottier	2 50
1 hand-hole trap—E. C. Cottier	1 15
235 ft. 4″ stove pipe for sewer drain—E. C. Cottier	35 25
250 ft. 1″ galv. iron pipe—E. C. Cottier	21 87
15 ft. ¾″ galv. iron pipe—E. C. Cottier	1 05
6 ft. 1″x ¾″ fittings—E. C. Cottier	75
5 garden valves—E. C. Cottier	3 00
Plumbing, Tulare Agricultural Experiment Station—J. C. Murray & Bro	8 67
1 can pure mixed paint, J. W.—Bass-Hueter Co.	1 25
5 cans pure mixed paint, O. W.—Bass-Hueter Co.	6 25
100 lbs. Prince's metallic, dry—Bass-Hueter Co.	2 00
10 gals. boiled linseed oil—Bass-Hueter Co.	5 50
2 gals. col. wood filler—Bass-Hueter Co.	4 00
2 gals. hard oil finish—Bass-Hueter Co.	3 50
1 gal. turpentine and new can—Bass-Hueter Co.	60
4 qts. carriage paint—Bass-Hueter Co.	2 00
2 lbs. burnt umber—Bass-Hueter Co.	20
2 lbs. burnt sienna—Bass-Hueter Co.	24
5 cans pure mixed paint, O. W.—Bass-Hueter Co.	6 25
1 can pure mixed paint, J. W.—Bass-Hueter Co.	1 25
50 lbs. Prince's metallic, dry—Bass-Hueter Co.	1 00
5 gals. boiled linseed oil—Bass-Hueter Co.	2 75
1 gal. floor paint, light drab—Bass-Hueter Co.	1 00
1 gal. turpentine and new can—Bass-Hueter Co.	60
2 qts. carriage paint—Bass-Hueter Co.	1 00
1 lb. chrome yellow—Bass-Hueter Co.	20
1 lb. coach black—Bass-Hueter Co.	15
1 lb. burnt umber—Bass-Hueter Co.	10
1 lb. burnt sienna—Bass-Hueter Co.	12
5 cans pure mixed paint, O. W.—Bass-Hueter Co.	6 25
1 can pure mixed paint, J. W.—Bass-Hueter Co.	1 25
50 lbs. Prince's metallic—Bass-Hueter Co.	1 00
10 gals. boiled linseed oil—Bass-Hueter Co.	5 50
1 gal. floor paint, light drab—Bass-Hueter Co.	1 00
1 gal. turpentine and new can—Bass-Hueter Co.	60
2 qts. carriage paint—Bass-Hueter Co.	1 00
1 lb. chrome yellow—Bass-Hueter Co.	20
1 lb. burnt umber—Bass-Hueter Co.	10
1 lb. burnt sienna—Bass-Hueter Co.	12
1 lb. coach black—Bass-Hueter Co.	15
5 cans pure mixed paint, O. W.—Bass-Hueter Co.	6 25
1 can pure mixed paint, J. W.—Bass-Hueter Co.	1 25
50 lbs. Prince's metallic—Bass-Hueter Co.	1 00
5 gals. boiled linseed oil—Bass-Hueter Co.	2 75
1 gal. light drab floor paint—Bass-Hueter Co.	1 00
1 gal. turpentine—Bass-Hueter Co.	60
2 qts. carriage paint—Bass-Hueter Co.	1 00
1 lb. chrome yellow—Bass-Hueter Co.	20
1 lb. coach yellow—Bass-Hueter Co.	15
5 cans pure mixed paint, O. W.—Bass-Hueter Co.	6 25
1 can pure mixed paint. J. W.—Bass-Hueter Co.	1 25
50 lbs. Prince's metallic—Bass-Hueter Co.	1 00
10 gals. boiled linseed oil—Bass-Hueter Co.	5 50
1 gal. light drab floor paint—Bass-Hueter Co.	1 00
1 gal. turpentine—Bass-Hueter Co.	60
2 qts. carriage paint—Bass-Hueter Co.	1 00
1 lb. chrome yellow—Bass-Hueter Co.	20
1 lb. coach black—Bass-Hueter Co.	15
	$323 53

APPENDIX No. 5 A—*State Appropriation for Support of Forestry Stations—Chico Station—Labor.*

Labor, month of June, 1895	$15 00
Labor, month of June, 1895	35 00
	$50 00

APPENDIX No. 5 B—*State Appropriation for Support of Forestry Stations—Chico Station—Supplies.*

76 ft. lumber—Sunset Lumber & Mill Co.	$1 52
Notary fees—Warren Cheney	50
	$2 02

APPENDIX No. 5 C—*State Appropriation for Support of Forestry Stations—Chico Station—Expressage.*

Expressage—Wells, Fargo & Co.	$0 29
Freightage—Southern Pacific Co.	25
Freightage—Southern Pacific Co.	2 39
	$2 93

APPENDIX No. 5 D—*State Appropriation for Support of Forestry Stations—Santa Monica Station—Labor.*

Labor, month of June, 1895	$15 00

APPENDIX No. 5 E—*State Appropriation for Support of Forestry Stations—Santa Monica Station—Supplies.*

Notary fees—Warren Cheney	$0 50

APPENDIX No. 5 F—*State Appropriation for Support of Forestry Stations—Chico Station—Labor.*

Labor, month of July, 1895	$52 00
Labor, month of August, 1895	67 55
Labor, month of November, 1895	32 50
Labor, month of December, 1895	31 25
Labor, month of January, 1896	29 50
Labor, month of February, 1896	31 25
Labor, month of March, 1896	26 75
Labor, month of April, 1896	30 75
Labor, month of May, 1896	32 50
	$334 05

APPENDIX No. 5 G—*State Appropriation for Support of Forestry Stations—Chico Station—Supplies.*

8 shoes—Tetreau & Horgan	$3 00
6,000 ft. common lumber—Sierra Lumber Co.	72 00
1,000 ft. flooring—Sierra Lumber Co.	20 00
3,000 shakes—Sierra Lumber Co.	21 00
2 windows, 10x12—Sierra Lumber Co.	2 00
1 door—Sierra Lumber Co.	1 13
180 lbs. assorted nails—Hubbard, Earll & Co.	7 20
1 lock—Hubbard, Earll & Co.	75
1 pr. hinges and 3 strap hinges—Hubbard, Earll & Co.	70
1 padlock—Hubbard, Earll & Co.	1 00
Notary fees—Warren Cheney	50
528 ft. common lumber—Sierra Lumber Co.	5 00
8 shoes—Tetreau & Horgan	2 00
60 lbs. barley—H. Lemm	50
Grinding 2,005 lbs. barley—Sperry Flour Co.	1 00
1 pr. blankets—Abramson Bros.	4 50
3 pillows—Abramson Bros.	1 20
200 shakes—H. Lemm	1 40
4 bolts and washers—John Bidwell	1 00
8 shoes—Tetreau & Horgan	3 00
1 ton ground barley—H. Lemm	12 50
Repairs to wagon—John Bidwell	6 00
900 lbs. seed wheat—H. Lemm	9 90
2,000 lbs. seed barley—H. Lemm	14 00
Notary fees—Warren Cheney	25
Assorted seeds—H. H. Berger & Co.	3 55
8 shoes set—Tetreau & Horgan	2 00
Assorted seeds—H. H. Berger & Co.	75
15 lbs. wire nails—Hubbard, Earll & Co.	75
1 daily journal—E. P. Taylor	1 25

State Appropriation for Support of Forestry Stations—Chico Station—Supplies— Continued.

Assorted seeds—J. H. Boyd	$0 60
1 lot assorted seeds—Carl Purdy	7 47
270 ft. lumber—Sierra Lumber Co.	3 50
2 harrow teeth and sharpening 46 teeth—John Bidwell	1 25
Lot of seed—H. H. Berger & Co.	2 40
8 shoes—Tetreau & Horgan	3 00
1 combination wrench—Osborn Hardware & Tool Co.	2 50
	$220 55

APPENDIX No. 5 H—*State Appropriation for Support of Forestry Stations—Chico Station—Traveling Expenses.*

Traveling expenses—C. H. Shinn	$21 10
Traveling expenses—C. H. Shinn	17 75
	$38 85

APPENDIX No. 5 I—*State Appropriation for Support of Forestry Stations—Chico Station—Expressage.*

Freightage—Southern Pacific Co.	$0 25
Expressage—Wells, Fargo & Co.	45
Freightage—Southern Pacific Co.	25
Freightage—Southern Pacific Co.	45
Expressage—Wells, Fargo & Co.	30
	$1 70

APPENDIX No. 5 J—*State Appropriation for Support of Forestry Stations—Chico Station—Postage.*

Postage stamps—John McCarthy, P. M.	$7 50
Postage stamps—John McCarthy, P. M.	7 50
	$15 00

APPENDIX No. 5 K—*State Appropriation for Support of Forestry Stations—Santa Monica Station—Labor.*

Month of July, 1895	$9 00
Month of December, 1895	12 00
Month of January, 1896	71 00
Month of February, 1896	72 50
Month of March, 1896	32 50
Month of April, 1896	32 50
Month of May, 1896	31 25
	$260 75

APPENDIX No. 5 L—*State Appropriation for Support of Forestry Stations—Santa Monica Station—Supplies.*

Notary fees—Warren Cheney	$0 50
1 halter—E. T. Smith	1 25
700 lbs. Nepaul barley—Germain Fruit Co.	12 25
1 whetstone—Germain Fruit Co.	25
1 ton coal—Geo. D. Pendleton	11 00
1 ton rolled barley—Geo. D. Pendleton	14 00
Shoeing 1 horse—Mobley Bros.	1 40
Shoeing 2 horses—Mobley Bros.	3 00
Setting tire—Mobley Bros.	25
105 lbs. barbed wire—J. S. Wilson	3 41
Stable fork—J. S. Wilson	85
25 lbs. nails—J. S. Wilson	1 00
Rubber packing—J. S. Wilson	70
Compounding 2 prescriptions—W. R. H. Sulliger	1 00
Notary fees—Warren Cheney	25
Assorted seeds—H. H. Berger & Co.	3 55
Assorted seeds—H. H. Berger & Co.	75
1 daily journal—E. P. Taylor	1 25
Assorted seeds—J. H. Boyd	55
Veterinary services—J. A. Edmonds	5 00
1 bottle ammonia—M. E. Chapin	25
2 pkgs. pearline—M. E. Chapin	25
3 pkgs. enameline—M. E. Chapin	25
1 broom—M. E. Chapin	30
1 mop and handle—M. E. Chapin	40
Shoeing 2 horses two times—Mobley Bros.	6 00
Sharpening shares—Mobley Bros.	35

State Appropriation for Support of Forestry Stations—Santa Monica Station—Supplies—Continued.

1 pot and cover—J. S. Wilson		$0 70
1 breadpan—J. S. Wilson		25
1 frypan—J. S. Wilson		35
1 saucepan—J. S. Wilson		45
1 tea kettle—J. S. Wilson		1 40
1 stewpan—J. S. Wilson		50
1 dipper—J. S. Wilson		30
2 milkpans—J. S. Wilson		55
86 ft. Oregon pine—Sunset Lumber & Mill Co.		1 51
1 coffee pot—J. S. Wilson		85
2 breadpans—J. S. Wilson		40
1 small agate pan—J. S. Wilson		25
1 wooden spoon—J. S. Wilson		10
1 soap dish—J. S. Wilson		20
Labor repairing house—J. Luce		2 50
1 marking gauge—J. S. Wilson		10
1 Maydole hammer—J. S. Wilson		60
1 hammer handle—J. S. Wilson		10
Chalk and line—J. S. Wilson		10
½ doz. files—J. S. Wilson		50
Ratchet brace—J. S. Wilson		1 10
Steel wire—J. S. Wilson		80
2 halters—J. S. Wilson		55
5 lbs. glue—J. S. Wilson		1 00
Whip and socket—J. S. Wilson		85
Currycomb and brush—J. S. Wilson		65
Rope—J. S. Wilson		10
Coal hod—J. S. Wilson		30
Screwdriver—J. S. Wilson		25
Buck saw—J. S. Wilson		90
Carpenter's square—J. S. Wilson		1 25
45 ft. ¾″ pipe—J. S. Wilson		3 15
2 faucets—J. S. Wilson		2 00
10 pipe fittings—J. S. Wilson		1 00
1 bathtub—J. S. Wilson		7 00
1 bathtub chain—J. S. Wilson		25
3 ft. 1¼″ lead pipe—J. S. Wilson		90
1 1¼″ trap—J. S. Wilson		75
1 union—J. S. Wilson		25
1 sheet zinc 7′x 1½′—J. S. Wilson		1 25
2 cans coal oil—J. S. Wilson		2 20
54 sq. ft. window netting—J. S. Wilson		1 35
10 lbs. nails—J. S. Wilson		50
1 putty knife—J. S. Wilson		20
1 gal. turpentine—J. S. Wilson		65
1 gal. boiled oil—J. S. Wilson		65
1 gal. floor paint—J. S. Wilson		1 50
2 gals. paint—J. S. Wilson		3 30
12 transoms, 36″x 24″—Sunset Lumber & Mill Co.		10 50
5 sashes, 3.9′x 3.10′—Sunset Lumber & Mill Co.		4 25
200 ft. Oregon pine—Sunset Lumber & Mill Co.		3 55
100 ft. redwood—Sunset Lumber & Mill Co.		2 00
170 ft. redwood, surfaced—Sunset Lumber & Mill Co.		5 10
100 ft. redwood, double surfaced—Sunset Lumber & Mill Co.		3 25
Sugar pine—Sunset Lumber & Mill Co.		75
3 bdls. laths—Sunset Lumber & Mill Co.		90
1 lot assorted seed—Carl Purdy		7 48
2 tons coal—G. D. Pendleton		22 00
2 lbs. wire brads—Lang & Middlekauff		20
½ pkg. glazier's points—Lang & Middlekauff		12
1 lb. glue and ½ lb. tacks—Lang & Middlekauff		35
25 lbs. flour—M. E. Chapin		60
1 "New Home" range—John F. Myers & Co.		22 05
Bill of W. I. Hull:		
9 window shades	$8 10	
135 rolls ingrain paper	20 25	
360 yds. muslin	21 60	
184 ft. molding	2 30	
18 papers tacks	1 80	
	$54 05	
Credit by paper and muslin returned	9 85	44 20

State Appropriation for Support of Forestry Stations—Santa Monica Station—Supplies—Continued.

1 18″x 30″ iron sink—J. S. Wilson	$2 50
Lot of seed—H. H. Berger & Co.	2 40
105 lbs. seed barley—G. D. Pendleton	75
4 cast-iron hose-menders—Lang & Middlekauff	20
1 wire strainer—Lang & Middlekauff	10
62 shrubs and trees—H. H. Berger & Co.	26 90
3 gopher traps—Lang & Middlekauff	66
1 pt. harness oil—G. Seallard	30
Repairs to harness—G. Seallard	35
Waterback in range—J. S. Wilson	4 50
3 lbs. putty—J. S. Wilson	15
Lime—J. S. Wilson	15
Brush—J. S. Wilson	50
Screws—J. S. Wilson	10
Sandpaper—J. S. Wilson	05
1 oil barrel—H. T. Meloy	75
18 ft. ¼ round lumber—Sunset Lumber & Mill Co.	13
4 ft. ½ round lumber—Sunset Lumber & Mill Co.	07
Surfacing lumber—Sunset Lumber & Mill Co.	50
2 bunches shakes—Sunset Lumber & Mill Co.	70
1 deputy constable's badge—T. C. Dougherty	1 00
5 sacks rolled barley—Gray & Son	3 25
1 garden fork—Lang & Middlekauff	1 00
½ doz. iron hose-menders—Lang & Middlekauff	50
1 pr. spring hinges—J. S. Wilson	25
1 screen door—Sunset Lumber & Mill Co.	1 75
14 shoes (horse)—Mobley Bros.	5 25
	$298 43

APPENDIX NO. 5 M—*State Appropriation for Support of Forestry Stations—Santa Monica Station—Traveling Expenses.*

Traveling expenses—C. H. Shinn	$18 55
Traveling expenses—J. H. Barber	50
Traveling expenses—C. H. Shinn	1 70
Traveling expenses—J. H. Barber	50
Traveling expenses—J. H. Barber	70
	$21 95

APPENDIX NO. 5 N—*State Appropriation for Support of Forestry Stations—Santa Monica Station—Expressage.*

Freightage—Southern Pacific Co.	$0 44
Freightage—Southern Pacific Co.	1 06
Freightage—Southern Pacific Co.	1 59
Expressage—Wells, Fargo & Co.	1 35
Freightage—Southern Pacific Co.	32
Freightage—Southern Pacific Co.	4 19
Expressage—Wells, Fargo & Co.	55
	$9 50

APPENDIX NO. 5 O—*State Appropriation for Support of Forestry Stations—Santa Monica Station—Postage and Stationery.*

Postage stamps—John McCarthy, P. M.	$7 50
2 pts. ink—J. J. Doran	80
1 lot bill heads—J. J. Doran	15
1 letter press—J. J. Doran	3 25
2 pencils—J. J. Doran	10
Postage stamps—John McCarthy, P. M.	7 50
	$19 30

APPENDIX NO. 6 A—*State Appropriation for Support of Viticulture—Labor.*

Labor, month of January, 1896	$69 00
Labor, month of January, 1896	15 00
Labor, month of February, 1896	51 00
Labor, month of March, 1896	34 00
Labor, month of April, 1896	90 00
3 days' labor—A. Campostrino	4 50
5 days' labor—J. Sigoulet	7 50
10 days' labor—G. H. Brown	30 00
6 days' labor—Isadore LeDuc	9 00
Labor, month of May, 1896	157 00
	$467 00

APPENDIX No. 6 B—*State Appropriation for Support of Viticulture—Traveling.*

Traveling expenses—F. T. Bioletti	$3 85
Traveling expenses—A. P. Hayne	7 60
One 3,000-mile railroad ticket—Southern Pacific Co.	75 00
Traveling expenses—F. T. Bioletti	4 35
Traveling expenses—F. T. Bioletti	10 90
Traveling expenses—F. T. Bioletti	17 10
Traveling expenses—A. P. Hayne	46 70
Traveling expenses—F. T. Bioletti	1 75
	$167 25

APPENDIX No. 6 C—*State Appropriation for Support of Viticulture—Vines.*

Custom-house duties—Aug. Rhotert	$7 10
Custom-house entry—Aug. Rhotert	1 50
Insurance (marine)—Balfour, Guthrie & Co.	40
22,000 vines—Vilorin, Andrieux & Co.	97 36
500 grape cuttings—Alameda Vineyard	5 00
	$111 36

APPENDIX No. 6 D—*State Appropriation for Support of Viticulture—Books and Periodicals.*

1 Frothingham—W. B. Saunders	$0 75
2 vols. Journal of Mycology—J. B. Ellis	7 40
	$8 15

APPENDIX No. 6 E—*State Appropriation for Support of Viticulture—Postage.*

Postage stamps—John McCarthy, P. M.	$25 00

APPENDIX No. 6 F—*State Appropriation for Support of Viticulture—Freight and Expressage.*

Freightage—Southern Pacific Co.	$5 22
Hauling freight—Wm. McLaughlin	5 00
Cartage on vines—Aug. Rhotert	1 50
Freight on vines—Aug. Rhotert	4 75
Telegrams—Western Union Tel. Co	6 44
Freight—Southern Pacific Co.	21 00
Telegram—Western Union Tel. Co.	40
	$44 31

APPENDIX No. 6 G—*State Appropriation for Support of Viticulture—Apparatus and Repairs.*

24 ft. molding—Niehaus Bros. Co.		$5 00
5⅓ days' labor—Geo. E. Brown		16 00
Bill of Pacific Lumber Co.:		
160 ft. pine	$1 92	
72 ft. redwood	1 08	
77 ft. redwood, beaded	1 37	
76 ft. redwood flooring	1 67	
1½ M shingles	1 95	
91 ft. rustic	1 82	
	$9 81	
Discount	1 91	
		7 90
Plastering one room—Whitney & Mara		8 40
480 ft. surfaced redwood—Pacific Lumber Co.		11 60
1 pr. pruning knives—J. Caire Co.		1 80
1 budding knife—J. Caire Co.		1 00
204 ft. surfaced redwood—Pacific Lumber Co.		5 35
1 grafting knife—J. Caire Co.		1 00
1 saw—J. Caire Co.		50
1 file—J. Caire Co.		10
1 emery stone—J. Caire Co.		35
3 pr. brackets—J. Caire Co.		70
Repairing one scale—A. Erlandsen		1 00
1 qt. carbon bisulph.—H. D. Kelsey		85
5 windows—Niehaus Bros. Co.		8 75
5 pulleys—Niehaus Bros. Co.		1 50
5 parting beads—Niehaus Bros. Co.		25
5 window stops—Niehaus Bros. Co.		30

State Appropriation for Support of Viticulture—Apparatus and Repairs—Continued.

2 gutters—Niehaus Bros. Co.	$5 45
2 corner molding—Niehaus Bros. Co.	2 25
5 bed molding—Niehaus Bros. Co.	1 00
1,481 ft. pine lumber—Pacific Lumber Co.	18 50
3,000 shingles—Pacific Lumber Co.	4 20
50 ft. rustic—Pacific Lumber Co.	1 00
128 ft. surface—Pacific Lumber Co.	3 07
1,303 ft. beaded—Pacific Lumber Co.	27 03
90 lbs. weights—Pacific Lumber Co.	1 45
Couplings, nipples, valve—A. Erlandsen	4 65
2 shades—E. Hook	1 40
2 doz. Florence flasks—J. Caire Co.	8 70
3 doz. Erlenmeyer flasks—J. Caire Co.	2 88
6 thermometers—J. Caire Co.	4 20
½ gross test-tubes—J. Caire Co.	4 75
1 nest of 10 beakers—J. Caire Co.	1 60
2 test-tube racks—J. Caire Co.	75
5 pipettes—J. Caire Co.	1 36
Graduate cylinders—J. Caire Co.	2 50
2 pkgs. S. & L. paper—J. Caire Co.	1 18
1 balance 8″ beam—J. Caire Co.	5 65
1 motor dynamo, size 1—Abner Doble & Co.	153 20
2 doz. Florence flasks—John Taylor & Co.	1 80
2 doz. glass plates—John Taylor & Co.	1 90
2 Mohr's pipettes—John Taylor & Co.	65
1 rm. white filter paper—John Taylor & Co.	3 60
2 sets glass funnels—John Taylor & Co.	1 00
3 4-oz. alcohol lamps—John Taylor & Co.	75
½ gal. alcohol—John Taylor & Co.	1 00
	$339 82

APPENDIX NO. 6 H—*State Appropriation for Support of Viticulture—Incidentals.*

Expenses for removing the property of the State Board of Viticulture to Berkeley	$98 00

APPENDIX NO. 7—*Expenditures from the State Appropriation for Affiliated Colleges.*

Searching title to Sutro site—Simpson & Millar	$75 00
Typewriting 2 copies "Advertisement for plans and specifications"—W. W. Guth	1 00
Computing assessments on land owned by Adolph Sutro—John Hall	30 00
Expressage on 10 pictures to Hopkins Institute—Patterson & Co.	2 00
Services rendered in making report on submitted designs for proposed buildings for Affiliated Colleges—Clinton Day, W. J. Mathews, Albert Pissis	500 00
Expressage on plans to Sacramento—Wells, Fargo & Co.	35
	$608 35

APPENDIX NO. 8—*College of Agriculture.*

1 load sand—M. Crabtree	$0 50
2 pkgs. tacks—E. W. Morgan	45
1 soldering iron—E. W. Morgan	50
1 pr. strap hinges—E. W. Morgan	15
1 pr. hinges—E. W. Morgan	20
2 hammer handles—E. W. Morgan	20
1 pick handle—E. W. Morgan	10
1 box stove, No. 18—Mitchell & Tutt Co.	3 75
6 lengths pipe—Mitchell & Tutt Co.	1 20
Hatchet—Mitchell & Tutt Co.	75
200 lbs. salt—J. McClain & Co.	1 60
1 year subscription to A B C Guide—Traffic Publishing Co.	2 50
Strainer and screw—Mitchell & Tutt Co.	25
Repairing cultivator—Nelson & McLellan	1 60
2 straps to cultivator—Nelson & McLellan	50
Splicing mower knife—Nelson & McLellan	75
8 horseshoes—Nelson & McLellan	3 00
Labor, month of June	370 20
Expressage—Patterson & Co.	6 50
Freight—Southern Pacific Co.	31
24 lbs. glucose—Rothschild & Ehrenpfort	1 20
1 Rockland, 4 x 4—Levi Strauss & Co.	2 90
1 saw filed—A. Erlandsen	25

College of Agriculture—Continued.

1,020 ft. Oregon pine—Henry W. Taylor	$12 85
480 ft. Oregon pine—Henry W. Taylor	6 05
12 tons hay baled—R. Moore	24 00
500 cu. ft. gas—Oakland Gas L. & H. Co.	1 12
4½ doz. picture hooks—A. Erlandsen	60
Granulated sugar—Congdon & Co.	50
2 bots. ink—P. P. Bernhardt & Co.	1 00
5 lbs. 16d wire nails—A. Erlandsen	20
1 doz. rubber washers—A. Erlandsen	10
2 repair links—A. Erlandsen	05
1 hose reducer—A. Erlandsen	25
1 hose reducer—A. Erlandsen	25
1 scrub brush—A. Erlandsen	20
6 ¾″ socket couplings—A. Erlandsen	50
1 tee and 2 bushings—A. Erlandsen	20
1½ doz. bolts and washers—A. Erlandsen	40
1 stable broom—A. Erlandsen	55
4 lbs. shot—A. Erlandsen	40
1 lb. powder—A. Erlandsen	50
1 8″ mill file—A. Erlandsen	20
1 box cherries—Stewart & Co.	75
Expressage—Wells, Fargo & Co.	30
Labor, month of July, 1895	421 00
Expressage—Patterson & Co.	6 50
1 doz. sheets backing, 8¾ x 13½—G. G. Wickson & Co.	40
50 sheets porous paper—G. G. Wickson & Co.	60
2 rolls cotton batting—M. C. Hamlin	20
Traveling expenses—E. Kellner	1 50
10 lbs. 6d wire nails—A. Erlandsen	60
3 papers double-pointed tacks—A. Erlandsen	15
2 tack hammers—A. Erlandsen	25
1 2″ union and 2″ tee—A. Erlandsen	65
3 bushings—A. Erlandsen	25
2½ ft. 1″ pipe—A. Erlandsen	25
Wire screen—A. Erlandsen	10
2 budding knives—A. Erlandsen	1 50
1 hook and staples—A. Erlandsen	05
1 gal. paint—S. Wakeham	1 75
Yellow ochre—S. Wakeham	10
2 spools wire—A. Erlandsen	20
Copper wire—A. Erlandsen	15
1 cradle—A. Erlandsen	3 00
3 shovels—A. Erlandsen	2 25
3 needles—A. Erlandsen	40
1 wheelbarrow—A. Erlandsen	2 50
1 pick handle—A. Erlandsen	25
1 key fitted—A. Erlandsen	25
1 wheelbarrow—A. Erlandsen	2 50
9 lbs. wire nails—A. Erlandsen	50
2 brooms—A. Erlandsen	50
3 saw files—A. Erlandsen	25
6 cast grates—Oakland Iron Works	3 00
8 lengths stovepipe—A. Erlandsen	2 00
2 elbows—A. Erlandsen	50
500 cu. ft. gas—Oakland Gas L. & H. Co.	1 15
2 picks sharpened—Nelson & McLellan	30
1 steel sharpened—Nelson & McLellan	90
1 share sharpened—Nelson & McLellan	35
8 horseshoes—Nelson & McLellan	4 00
Labor, month of August, 1895	401 85
Expressage—Patterson & Co.	7 38
Expressage—Wells, Fargo & Co.	17 05
Telegrams—Western Union Tel. Co.	2 27
Telegrams—Western Union Tel. Co.	80
Telegrams—Western Union Tel. Co.	75
½ lb. hide powder, and postage—J. Fiebing	3 60
Telegrams—Western Union Tel. Co.	1 09
1 bottle brush—J. Caire Co.	45
1 gal. bisulph. carbon—J. Caire Co.	1 25
1 pruning knife—J. Caire Co.	1 00
6 splint baskets—Congdon & Co.	50
Telephone message—Sunset Tel. & Tel. Co.	60
1 can yellow paint—S. Wakeham	50
1 gal. linseed oil—S. Wakeham	75

College of Agriculture—Continued.

	Repairing harness—S. Taylor	$1 40
	Traveling expenses—E. Kellner	90
6	lbs. galv. wire—A. Erlandsen	50
1	can chloride lime—H. D. Kelsey	25
5	lbs. 20d wire nails—A. Erlandsen	25
9	lbs. 6d wire nails—A Erlandsen	50
1	sledge handle—A. Erlandsen	20
3	lbs. galv. wire—A Erlandsen	30
1	steel rake—A. Erlandsen	55
1	gal. boiled oil—S. Wakeham	75
1	gal. turpentine—S. Wakeham	60
	Paint brush—S. Wakeham	50
1	qt. paint—S. Wakeham	40
	Labor, September	408 75
1,700	cu. ft. gas—Oakland Gas L. & H. Co.	3 40
800	cu. ft. gas—Oakland Gas L. & H. Co.	1 80
	Labor, month of October	297 25
2	pieces, 2″x 18″x 16′ surfaced redwood—Henry W. Taylor	2 70
	Traveling expenses—Julius Koebig	3 50
50	ft. No. 18 C. C. lamp cord—California Electrical Works	1 20
2	loads sand—Mrs. M. Crabtree	1 00
1,400	pot labels—Sunset Seed & Plant Co.	1 45
	Hauling away dead horse—Baumann & Will	2 00
20	ft. No. 18 wire—California Electrical Works	50
1	gal. boiled oil—S. Wakeham	75
1	pruning knife—J. Caire Co.	1 00
2	sieves—J. Caire Co.	55
1	granite pot—J. Caire Co.	1 80
5	lbs. zinc—J. Caire Co.	50
1	6″ stovepipe elbow—A. Erlandsen	25
1	lb. galv. wire—A. Erlandsen	15
	Fly paper—H. D. Kelsey	25
1	lb. gold label gelatine—C. C. Riedy	80
4	bundles elder pith—C. C. Riedy	40
12	doz. assorted screws—M. Everson	85
2	halter chains—M. Everson	60
5	pkgs. tacks—M. Everson	25
2	prs. wire plyers—M. Everson	80
1	Yost typewriter pad—H. Simons	2 00
1	Yost bell cord—H. Simons	15
1	chain—Pierce Hardware Co.	50
2	canvas record books—H. Simons	90
6	Manilla-cover counter books—H. Simons	50
4	memoranda—H. Simons	40
2	billhead tablets—H. Simons	20
2	bots. Carter's paste—H. Simons	20
	Expressage—Patterson & Co.	5 25
1	horse—Neil Kelly	75 00
2,000	lbs. rolled barley—Congdon & Co.	14 50
1,000	lbs. bran—Congdon & Co.	7 75
	Traveling expenses—A. J. Cook	20 00
	Labor, month of November	322 25
1	step-ladder chair—E. Hook	3 50
9	lbs. C. P. sulph. acid—J. Caire Co.	1 98
	Copper wire—A. Erlandsen	50
1	load of propagating sand—Thermal Vale Nursery	1 00
	Screw for chopper—A. Erlandsen	40
1	coal shovel—A. Erlandsen	1 25
1	lantern—A. Erlandsen	75
1	claw hatchet—A. Erlandsen	60
4	doz. screw eyes—A. Erlandsen	40
1	doz. screw bolts—A. Erlandsen	75
5⅝	lbs. galv. wire—A. Erlandsen	50
1½	lbs. copper wire—A. Erlandsen	55
6	garden valves—A. Erlandsen	5 00
26	lbs. hay rope—L. Foard	1 30
2	qts. white paint—S. Wakeham	1 10
3	typewriter ribbons—G. C. Hardy	1 85
100	lbs. Manilla hawser—L. Foard	3 00
	Fly paper—H. D. Kelsey	25
1	bbl. lime—Barker & Hunter	1 50
	Telegraphing—Pacific Postal Tel.-Cable Co.	3 35
29	lbs. sphognum moss—Sunset Seed & Plant Co.	2 03
1	bag peat—Sunset Seed & Plant Co.	1 00

College of Agriculture—Continued.

Expressage—Wells, Fargo & Co.	$1 10
Traveling expenses—E. J. Wickson	47 10
Traveling expenses—E. W. Hilgard	11 85
Traveling expenses—A. J. Cook	107 28
Traveling expenses—A. J. McClatchie	16 30
700 cu. ft. gas—Oakland Gas L. & H. Co.	1 40
1,600 cu. ft. gas—Oakland Gas L. & H. Co.	2 80
Blacksmithing—Nelson & McLellan	8 50
Labor, December	354 75
3 doz. ⅝ solio—Henry Kahn & Co.	1 35
1 alarm clock—W. G. Scott	1 50
1 box McGill fasteners—Brown & Power	25
1 anvil—J. Caire Co.	2 70
2 case locks—A. Erlandsen	80
2 door bolts—A. Erlandsen	25
1 platinum spatula—J. Caire Co.	2 85
1 iron chimney—J. F. Meyer & Co.	75
Freight—Southern Pacific Co.	67
1 auger—E. R. Tutt	2 00
1 box scraper—A. Erlandsen	35
1 bucksaw—A. Erlandsen	1 00
2 keys fitted—A. Erlandsen	45
Telegrams—Western Union Tel. Co.	1 65
Labor, month of January, 1896	378 75
1 doz. drawer pulls—J. Caire Co.	40
10 ft. rubber tube—J. Caire Co.	50
2 thermometers—J. Caire Co.	30
1 lb. carbolic acid, pure—J. Caire Co.	55
2 lbs. lead acetate—J. Caire Co.	40
6 glass funnels—J. Caire Co.	75
Tracing cloth—E. P. Bancroft	40
1 ruling pen—E. P. Bancroft	20
8 packing cases—E. P. Bancroft	2 00
1 cutter for roots—J. Caire Co.	3 00
Expressage—Patterson & Co.	25
1 lb. beeswax—F. V. Baer	65
1 gal. Little's sheep dip—Flint's Pharmacy	3 00
Stencil cloth—Levi Strauss & Co.	3 15
1 doz. sand soap—Congdon & Co.	50
Telegrams—Western Union Tel. Co.	1 20
Pins—Max Greenhood & Co.	20
1 padlock—A. Erlandsen	50
2 lbs. copper wire—A. Erlandsen	70
1 Acme wrench—A. Erlandsen	85
Leather washers—A. Erlandsen	15
1 mattock, with handle—A. Erlandsen	1 15
1 daily journal, 1896—E. P. Taylor	1 25
Sharpening 2 mattocks—Nelson & McLellan	75
8 horseshoes—Nelson & McLellan	4 00
Repairing cultivator, plow, etc.—Nelson & McLellan	4 70
Blacksmithing—Nelson & McLellan	6 75
Labor, month of February, 1896	346 75
1 Stanley plane—G. Cashmore	15
1 Stanley plane—G. Cashmore	40
1 pr. scissors—G. Cashmore	85
2 doz. oil boards—C. H. Hardy	70
7,200 cu. ft. gas—Oakland Gas L. & H. Co.	13 00
8,500 cu. ft. gas—Oakland Gas L. & H. Co.	15 45
2 pruning knives repaired—A. Erlandsen	50
1 foot bolt—A. Erlandsen	30
1 doz. rubber washers—A. Erlandsen	10
3 garden hoes—A. Erlandsen	1 25
1 10″ mill flat file—A. Erlandsen	25
106 lbs. oats—George N. Martin	1 40
2 galv. watering-pots—A. Erlandsen	2 00
1 Ames shovel—A. Erlandsen	1 25
1 cross-cut saw filed and set—A. Erlandsen	50
Saw filed, and handle put on ax—A. Erlandsen	50
1 door mat—A. Erlandsen	1 00
2 foot-scrapers—A. Erlandsen	40
9 pieces 2″x 12″x 18′ redwood—Pacific Lumber Co.	4 70
Telegrams—Western Union Tel Co.	2 20
1 sponge eraser—Students' Coöp. Ass'n	20
Traveling expenses—E. J. Wickson	5 30

College of Agriculture—Continued.

Traveling expenses and salary—A. J. Cook		$32 65
Labor, March, 1896		351 55
Traveling expenses—E. J. Wickson		53 65
Traveling expenses and salary—A. J. Cook		67 52
2,000 lbs. rolled barley—Congdon & Co.		16 50
2,000 lbs. bran—Congdon & Co.		13 00
3 long tons Wellington coal—J. C. Wilson & Co.		26 22
3 long tons Welch Egg Anthracite—J. C. Wilson & Co.		28 47
1 sk. oats, 103 lbs.—G. N. Martin		1 25
2 doz. thumb tacks—Students' Coöp. Ass'n		20
10 lbs. 20d wire nails—A. Erlandsen		50
1 saw filed—A. Erlandsen		25
2 ax handles—A. Erlandsen		45
1 ax handle—A. Erlandsen		15
1 cross-cut saw filed and set—A. Erlandsen		90
Galv. wire staples—A. Erlandsen		25
1 hose coupling put on, and washers—A. Erlandsen		30
6 pieces plaster brad—Niehaus Bros. Co.		85
Expressage—Patterson & Co.		1 25
Freight—Southern Pacific Co.		80
Expressage—Wells, Fargo & Co.		1 49
Blacksmithing—Nelson & McLellan		3 95
500 feet ¾″ black pipe—Holbrook, Merrill & Stetson		16 87
6 ¾″ black tees—Holbrook, Merrill & Stetson		18
6 faucets to fit pipe—Holbrook, Merrill & Stetson		3 00
6,500 cu. ft. gas—Oakland Gas L. & H. Co.		11 38
6 lectures, and traveling expenses—A. J. McClatchie		39 50
7,100 cu. ft. gas—Oakland Gas L. & H. Co.		12 42
Expressage—Patterson & Co.		3 75
Labor, month of April		338 00
Traveling expenses—E. J. Wickson		6 00
Blacksmithing—Nelson & McLellan		4 70
1 bag salt—Congdon & Co.		10
Map of California—W. B. Walkup		2 50
1 bbl. lime—Foss & McNulty		1 75
30 ¾″ plain black tees—Holbrook, Merrill & Stetson		90
1 bolt cotton cloth—Levi Strauss & Co.		3 05
5,800 cu. ft. gas—Oakland Gas L. & H. Co.		10 15
Traveling expenses—William Winterhalter		1 20
12 lbs. putty—S. Wakeham		60
2¾ lbs. rope, ¼″—Joseph McClain & Co.		50
1 garden trowel—A. Erlandsen		50
1 lb. galv. staples—A. Erlandsen		15
Hose bands—A. Erlandsen		40
Expressage—Patterson & Co.		25
Blacksmithing—Nelson & McLellan		1 85
Labor, month of May		357 75
Plaster cast of the bust of Justin S. Morrill—Henry E. Alvord		45 00
Traveling expenses (Farmers' Institutes)—E. J. Wickson		64 65
Traveling expenses (Farmers' Institutes)—A. J. Cook		65 90
Services (Farmers' Institutes)—A. J. Cook		67 50
Services (Farmers' Institutes)—A. J. Cook		52 50
Traveling expenses (Farmers' Institutes)—A. J. Cook		27 82
Postage and stationery (Farmers' Institutes)—A. J. Cook		9 46
		$5.712 42

APPENDIX No. 9—*College of Chemistry.*

Customs charges—C. D. Bunker & Co.		$22 70
1 bbl. alcohol—C. Jost & Son		30 73
Customs charges—C. D. Bunker & Co.		8 00
Expressage—Patterson & Co		1 00
Freight—Southern Pacific Co.		50
Marine insurance—Balfour, Guthrie & Co.		2 90
Photomicrographic camera and 1 plate-holder—Cal. Optical Co.	$36 00	
Rectangular tube, with prism—California Optical Co.	7 75	
1 doz. each dry plates, 2200-25-30-35—California Optical Co.	3 50	
	$47 25	
Less	5 76	
		41 49
1 doz. iron Bunsen burners—John Taylor & Co.		6 00
1 doz. Bunsen clamps—John Taylor & Co.		7 80
1 doz. Bunsen burners, 5x½—John Taylor & Co.		4 20
100 ft. black rubber tubing, ⅛″ bore—John Taylor & Co.		50

College of Chemistry—Continued.

10 lbs. oxalic acid—John Taylor & Co.		$1 25
100 ft. rubber tubing—J. Caire Co.		2 80
100 ft. black rubber tubing, ¼″—J. Caire Co.		4 50
100 ft. black rubber tubing, ⅜″—J. Caire Co.		6 75
8 gross taper corks, ⅛″—J. Caire Co.		2 07
10 lbs. hypo. soda—J. Caire Co.		38
3,400 cu. ft. gas—Oakland Gas L. & H. Co.		7 65
Bill of James R. McDonald & Co., for goods purchased of E. de Haen:	Marks.	
1 kiste Bleicheinsatz	2.00	
½ hg. sodium hyperoxide, pure	15.00	
2 hg. sodium hyperoxide, com.	10.00	
1 kiste B. 11.5 hg.	2.00	
1 hg. calcium phosphide	5.00	
100° carbon bichloride	2.50	
100° carbon trichloride	7.50	
100° nitroxylol	2.80	
20° acid aconitic	.40	
20° silicium chloride	2.00	
10° silicium bromide	2.50	
100° ammon. bromat	3.75	
500° sulphur dichloride	.50	
100° sulphur iodide	3.50	
100° sulphur oxychloride	2.00	
50° titanium chloride	4.50	
Flaschen	5.70	
	71.65	
Freightage, commission, etc.	35.50	
	107.15	25 98
Freightage—Southern Pacific Co.		5 76
Expressage—Patterson & Co.		20 75
Expressage—Patterson & Co.		75
Bill of T. P. Andrews:		
1 rubber focusing cloth (large), 2 yds. long	$0 90	
1 R. O. Co.'s printing frame, to open two thirds, 4x5	36	
1 R. O. Co.'s printing frame, to open two thirds, 5x8	50	
1 R. O. Co.'s printing frame, to open two thirds, 6½x8½	54	
Vulcanized rubber developing trays:		
1 4x5, shallow	30	
1 5x8, shallow	60	
1 6½x8½, shallow	75	
1 4x5, deep	50	
1 5x8, deep	70	
1 6½x8½, deep	85	
Negative preservers:		
6 pkgs. 4x5	1 20	
4 pkgs. 5x7	1 20	
4 pkgs. 5x8	1 20	
4 pkgs. 6½x8½	1 40	
2 doz. 4x5 Seed No. 26 plates	1 30	
2 doz. 4x5 Seed No. 27 plates	1 30	
1 doz. 5x7 Seed No. 26 plates	1 10	
1 doz. 5x8 Seed No. 26 plates	1 25	
1 doz. 6½x8½ Seed No. 26 plates	1 65	
		17 60
3 lbs. iod. potassium—Mack & Co.		9 00
10 lbs. sulphite soda—Mack & Co.		1 00
50 lbs. carbonate soda—Mack & Co.		75
10 lbs. carbonate potash—Mack & Co.		1 50
6 oz. hydrochinon—Mack & Co.		1 50
4 qts. peroxide hydrogen—Mack & Co.		1 40
9,200 cu. ft. gas—Oakland Gas L. & H. Co.		20 70
½ rm. 20 Japanese folio—Blake, Moffitt & Towne		2 80
½ rm. 24 Japanese folio—Blake, Moffitt & Towne		3 36
½ rm. 16 Japanese folio—Blake, Moffitt & Towne		2 40
1 M 542-6 envelopes—Blake, Moffitt & Towne		1 26
1 M 7412-5 envelopes—Blake, Moffitt & Towne		1 65
Expressage—Patterson & Co.		11 75
1 large Mignon shutter—Henry Kahn & Co.		7 50
8 gross flat head iron screws, ¼″, ¾″, ½″, ¾″—J. Caire Co.		90
25 rim night latches—J. Caire Co.		1 70

College of Chemistry—Continued.

6 Sadler's driver, assorted sizes—J. Caire Co.		$0 20
200 sq. ft. iron wire cloth, small mesh—J. Caire Co.		20
50 lbs. sulph. copper—Mack & Co.		2 25
5 lbs. po. tart. acid—Mack & Co.		1 75
1 rm. 38-44 G. tint, cut—Blake, Moffitt & Towne		2 20
1 gal. boiled linseed oil—W. P. Fuller & Co.		85
Turpentine—W. P. Fuller & Co.		2 40
10 lbs. paraffine—Langley & Michaels Co.		1 00
25 lbs. bleaching powder—Langley & Michaels Co.		1 00
10 lbs. red lead—Langley & Michaels Co.		75
50 lbs. sulph. iron—Langley & Michaels Co.		1 00
8 gross corks—Langley & Michaels Co.		9 18
Bill of H. S. Crocker Co.:		
3 record books, 150 pages	$0 75	
3 record books, 300 pages	1 35	
12 mem. books	1 00	
3 mem. books	30	
3 mem. books	45	
3 mem. books	45	
3 mem. books	60	
1 miniature bk. record	1 60	
1 miniature bk. record	1 00	
1 miniature bk. record	1 25	
1 qt. Sanford paste	50	
6 Quadrille note pad	75	
6 blotting pads	25	
4 boxes sealing wax	1 40	
1 qt. bottle mucilage	50	
1 mucilage bottle, medium	15	
		12 30
1 carboy—John Taylor & Co.		2 25
140 lbs. com'l nitric acid—John Taylor & Co.		9 10
5 lbs. sealing wax—John Taylor & Co.		1 50
1 Rohrbah scale—John Taylor & Co.		2 18
3 brass weights—John Taylor & Co.		4 50
2 lbs. litmus, gran.		90
1 set troy weights—John Taylor & Co.		2 25
2 carboys ammonia—Mack & Co.		11 94
2 carboys—Mack & Co.		4 50
5 lbs. vaseline—Mack & Co.		1 21
5 lbs. fruit wax—Mack & Co.		25
2 Roberwahl scales, ½ kilo—J. Caire Co.		2 90
1 Troemner scale—J. Caire Co		6 75
50 lbs. plaster Paris—J. Caire Co.		1 50
2 record books, 2-quire—Dutton & Partridge		48
2 record books, 4-quire—Dutton & Partridge		96
2 record books, 6-quire—Dutton & Partridge		1 44
2 pass books—Dutton & Partridge		24
1 3-quire record—Dutton & Partridge		1 00
1 6-quire record—Dutton & Partridge		2 00
1 box pens—Dutton & Partridge		65
1 large mucilage bottle—Dutton & Partridge		25
6 mucilage brushes, assorted—Dutton & Partridge		10
1 washer cutter—Miller, Sloss & Scott		90
2 gro. 1″ (assorted nos.) screws—Miller, Sloss & Scott		40
2 Yale padlocks—Miller, Sloss & Scott		1 48
2 Yale padlocks—Miller, Sloss & Scott		1 80
1 hatchet, 5″ cut—Miller, Sloss & Scott		60
1 set solid punches (4)—Miller, Sloss & Scott		65
5 gals. boiled linseed—F. N. Woods & Co.		3 15
5 gals. black asph. varnish—F. N. Woods & Co.		3 25
10 lbs. black paint—F. N. Woods & Co.		60
10 lbs. white zinc paint—F. N. Woods & Co.		85
1 4″ flat paint brush—F. N. Woods & Co.		35
1 2″ flat paint brush—F. N. Woods & Co.		25
2 3″ C. H. brushes—F. N. Woods & Co.		90
2 2″ C. H. brushes—F. N. Woods & Co.		50
2 1″ C. H. brushes—F. N. Woods & Co.		30
2 doz. C. H. pencils—F. N. Woods & Co.		1 00
10 gals. gasoline—F. N. Woods & Co.		2 50
3 bots. Amer. India ink—F. N. Woods & Co.		1 05
30 lbs. sheet copper, Nos. 15, 20, and 25—Dunham, Carrigan & Hayden Co.		7 50
1 gross O. O. brass screws, ½ x 3—Dunham, Carrigan & Hayden Co.		30
1 ax, 4 lbs.—Dunham, Carrigan & Hayden Co.		75

College of Chemistry—Continued.

1 hatchet, No. 3—Dunham, Carrigan & Hayden Co.		$0 40
1 grub-hoe handle—Dunham, Carrigan & Hayden Co.		70
6 glass cutters—Dunham, Carrigan & Hayden Co.		60
1 sq. tubular lantern—Dunham, Carrigan & Hayden Co.		50
1 Summit L. H. spade—Dunham, Carrigan & Hayden Co.		75
1 Sunset L. H. shovel—Dunham, Carrigan & Hayden Co.		75
1 wheelbarrow—Dunham, Carrigan & Hayden Co.		3 50
2 prs. paper shears, 12″—Dunham, Carrigan & Hayden Co.		1 60
1 Giant nail puller—Dunham, Carrigan & Hayden Co.		1 45
1 marking and cutting gauge—Dunham, Carrigan & Hayden Co.		20
1 adjustable iron sliding T bevel, 8″—Dunham, Carrigan & Hayden Co.		25
1 boxwood rule—Dunham, Carrigan & Hayden Co.		25
6 prs. straight trimmers, 6″—J. Caire Co.		1 50
2 prs. straight trimmers, 8″—J. Caire Co.		60
2 iron pocket levels—J. Caire Co.		30
1 Davis iron level, 24″—J. Caire Co.		2 50
6 common rules—J. Caire Co.		50
20 lbs. sulphur flowers—J. Caire Co.		70
5 lbs. orange shellac—J. Caire Co.		1 85
Bill of Miller, Sloss & Scott:		
21 lbs. wire nails, assorted	$2 07	
2 lengths ⅜″ black pipe	90	
3 lbs. No. 16 annealed wire	30	
3 lbs. No. 18 annealed wire	30	
5 lbs. No. 10 annealed wire	35	
5 lbs. No. 12 annealed wire	35	
5 lbs. No. 14 annealed wire	50	
	$4 77	
Less	47	4 30
300 ft. T. & G. redwood—Pacific Tool & Lumber Co.		6 63
50 ft. pine—Pacific Tool & Lumber Co.		59
50 lbs. rock salt—Congdon & Co.		40
50 lbs. table salt—Congdon & Co.		50
12 cakes sapolio—Congdon & Co.		95
12 cakes ivory soap—Congdon & Co.		95
Expressage—Wells, Fargo & Co.		75
Bill of Paul P. Bernhard & Co.:		
1 font Q solid rubber	$1 80	
3 holders	1 35	
4 solid rubber stamps	1 00	
1 font 1½″ markers and figures	8 25	
2 pads	50	
3 bots. ink	3 00	
	$16 40	
Less 20%	3 28	13 12
50 ft. each Nos. 15, 20, 25, 30, and 35, D. S. S. magnet wire—Paul Seiler Electrical Works		1 50
36 zincs, 1″x 6″x ⅜″—Paul Seiler Electrical Works		4 50
36 Fuller zincs—Paul Seiler Electrical Works		5 76
12 binding screws—Paul Seiler Electrical Works		1 92
2 doz. Chapman's filter pumps—Henry Heil Chemical Co.		20 00
Bill of George Breck:		
1 Wellsbach attachment	$15 00	
1 gross cover-glasses	3 60	
1 gross mats, No. 1	1 50	
1 gross mats, No. 2	1 50	
25 mats, No. 3	25	
25 mats, No. 4	25	
900 binders	1 80	
	$23 90	
Less 10%	2 40	21 50
1 cover-glass gauge—California Optical Co.		2 30
1 microtome—California Optical Co.		7 90
1 knife—California Optical Co.		4 00
1 gross trans. Carbutt's plates, 3¼x4—Henry Kahn & Co.		6 00
½ gross 4x5 dry Seed plates, No. 26—Henry Kahn & Co.		3 60
½ gross 4x5 Carbutt's plates, ortho portrait—Henry Kahn & Co.		3 60
1 gross ⅝ solio paper—Henry Kahn & Co.		3 60

College of Chemistry—Continued.

1 roll sheet zinc—Holbrook, Merrill & Stetson	$7 70
50 lbs. scrap zinc—Holbrook, Merrill & Stetson	2 50
16,800 cu. ft. gas—Oakland Gas L. & H. Co.	29 40
12,000 cu. ft. gas—Oakland Gas L. & H. Co.	24 00
200 yds. cotton cloth—Salinger Bros.	10 00
50 ft. pure rubber tubing, ¼″—John Taylor & Co.	2 75
6 hydrometers—John Taylor & Co.	2 40
22 bottles—John Taylor & Co.	5 50
16 bots., 96 lbs. muriatic acid, C. P.—John Taylor & Co.	13 44
7 bots., 49 lbs. nitric acid, C. P.—John Taylor & Co.	6 86
36 No. 8 rubber stoppers, 2-hole—John Taylor & Co.	3 75
24 No. 7 rubber stoppers, 2-hole—John Taylor & Co.	2 00
100 ft. heavy rubber tubing, ¼″ bore—John Taylor & Co.	3 40
50 ft. pure rubber tubing, ⅛″ bore—John Taylor & Co.	88
100 ft. pure rubber tubing, $\frac{3}{16}$″ bore—John Taylor & Co.	2 50
1 doz. pkgs. 1-oz. tacks—J. Caire Co.	29
1 doz. pkgs. 2-oz. tacks—J. Caire Co.	35
2 doz. pkgs. 4-oz. tacks—J. Caire Co.	88
2 doz. pkgs. 6-oz. tacks—J. Caire Co.	94
2 doz. pkgs. 8-oz. tacks—J. Caire Co.	1 00
1 flask mercury—J. Caire Co.	41 00
Postage stamps—John McCarthy, P. M.	7 50
24 stools—Indianapolis Furniture Co.	20 00
3 stools—Indianapolis Furniture Co.	3 75
2 stools—Indianapolis Furniture Co.	4 50
1 doz. perforated stools—Indianapolis Furniture Co.	10 00
3 doz. perforated seats—Indianapolis Furniture Co.	2 10
2 coils No. 15 copper wire stubbs—Washburn & Moen Mfg. Co.	1 57
2 coils No. 20 copper wire stubbs—Washburn & Moen Mfg. Co.	1 78
2 coils No. 25 copper wire stubbs—Washburn & Moen Mfg. Co.	2 10
Expressage—Patterson & Co.	7 50
Expressage—Patterson & Co.	5 00
20 pieces clear pine, 252 ft. clear pine—Henry W. Taylor	7 31
Marine insurance—Balfour, Guthrie & Co.	8 25
6 gross clay pipe-stems—C. P. Heininger	3 00
6 brass binding posts, No. 3—Paul Seiler Electrical Works	75
6 brass binding posts, No. 7—Paul Seiler Electrical Works	75
6 pr. connectors, No. 18—Paul Seiler Electrical Works	60
6 pr. connectors, No. 19—Paul Seiler Electrical Works	60
7 ¼ doz. slim taper files—Dunham, Carrigan & Hayden Co.	4 91
6 sheets carbon paper—E. P. Bancroft	25
1 doz. sash locks—F. W. Wright	80
1 Novelty staple set—Le Count Bros.	. 50

Bill of James R. McDonald & Co. for glassware, purchased of Franz Schilling; in marks, total in dollars and cents:

	Marks.
23 fractional distillation flasks, 300 gr.	16.00
55 fractional distillation flasks, 200 gr.	19.80
20 flasks, 1,000 gr.	6.40
50 flasks, 250 gr.	6.75
50 flasks, 100 gr.	4.25
50 flasks, 250 gr., flat bottomed	8.50
100 flasks, 100 gr., flat bottomed	9.50
10 condensers, 40 cm. long	14.00
5 wash bottles	5.50
3 wash bottles, for gases, 100 gr.	2.70
2 sets extraction apparatus, 1,000 gr.	4.60
2 sets extraction apparatus, 750 gr.	4.10
2 sets extraction apparatus, 500 gr.	3.60
2 sets extraction apparatus, 250 gr.	2.90
2 sets extraction apparatus, 100 gr.	2.20
10 pointed balloons, 200 gr.	3.50
5 kryophors	5.50
2 worm condensers	2.40
2 gas wash bottles	3.10
2 pulse glasses	1.20
2 water hammers	1.10
10 arsenic tubes	5.00
5 gas wash bottles, 250 gr.	4.50
20 glass connections	13.00
1 sympathetic thermometer	.65
10 adapters, bent, 20 mm.	2.40
20 adapters, straight, 15–20 mm.	4.00

College of Chemistry—Continued.

Bill of James R. McDonald & Co.—Continued.

	Marks.
20 bulb tubes with 1 bulb, hard glass	6.00
40 bulb tubes with 2 bulbs, hard glass	14.00
20 chloride of calcium tubes, 15 cm.	2.88
5 blow pipes	1.75
100 arsenic testers, No. 332	3.60
100 arsenic testers, No. 333	3.60
100 arsenic testers, No. 335	3.60
100 arsenic testers, No. 336	3.60
50 flasks, 750 gr.	13.75
5 retorts, 200 gr.	1.80
5 retorts, 250 gr.	2.00
5 retorts, 500 gr.	2.70
5 retorts, 100 gr.	1.32
20 flasks, blown in the lamp, 25 gr.	2.00
20 flasks, blown in the lamp, 20 gr.	1.80
20 flasks, blown in the lamp, 15 gr.	1.60
20 flasks, blown in the lamp, 10 gr.	1.40
5 T tubes, 50 mm.	.50
5 T tubes, 60 mm.	.60
5 T tubes, 80 mm.	.90
5 T tubes, 100 mm.	1.50
20 chloride of calcium tubes, 15 cm. (No. 431)	8.10
20 chloride of calcium tubes, 15 cm. (No. 433b)	8.10
5 distillation tubes with 2 bulbs	6.00
3 distillation tubes with 3 bulbs	5.40
2 distillation tubes with 4 bulbs	4.80
2 distillation tubes with 5 bulbs	7.20
2 distillation tubes with 6 bulbs	9.60
20 thistle tubes, bell-mouthed	5.00
20 thistle tubes, funnel-mouthed	5.40
20 extraction apparatus, 100 gr.	42.00
20 extraction apparatus, 60 gr.	35.00
6 combustion tubes, 80 cm.	4.50
5 combustion tubes, 60 cm.	2.50
20 measuring pipettes, 1 cc.	3.00
20 measuring pipettes, 2 cc.	3.00
10 measuring pipettes, 3 cc.	1.60
10 measuring pipettes, 4 cc.	1.70
20 measuring pipettes, 5 cc.	3.60
20 measuring pipettes, 10 cc.	4.40
10 measuring pipettes, 15 cc.	2.40
10 measuring pipettes, 20 cc.	3.00
20 measuring pipettes, 25 cc.	7.00
5 measuring pipettes, 75 cc.	8.40
5 measuring pipettes, 100 cc.	3.50
2 measuring pipettes, 150 cc.	1.70
2 measuring pipettes, 200 cc.	2.00
2 measuring cylinders, 100 cc.	1.80
10 measuring flasks, 50–55 c.cm.	3.50
10 measuring flasks, 50 c.cm.	2.70
10 measuring flasks, 100 c.cm.	3.00
10 measuring pipettes with scale tube, 50 cc.	7.00
10 connecting tubes, 6–10 mm.	4.00
42 fraction flasks, 250 gr.	17.64
1 retort and condensers, 50 gr.	.75
1 retort and condensers, 75 gr.	.75
1 retort and condensers, 100 gr.	.80
1 retort and condensers, 125 gr.	.90
1 retort and condensers, 150 gr.	.90
1 retort and condensers, 200 gr.	1.10
30 Mohr's apparatus	36.00
20 separating funnels, bell form, 60 gr.	31.00
30 separating funnels, bell form, 60 gr.	45.00
20 separating funnels, cylindrical, 60 gr.	30.00
5 stopcocks, 6 mm. tube	15.00
50 fraction flasks, 100 gr.	12.00
185 Prince Rupert drops	4.44
20 connection stopcocks, 2 mm. tube	23.00
2 connection stopcocks, 2 mm. tube (hollow centers)	34.00
2 three-way cocks	3.60
1,000 test tubes, 150x16 mm.	32.50
2,000 test tubes, 120x13 mm.	40.00
1,000 test tubes, 150x13 mm.	26.50
500 test tubes, 150x20 mm.	18.50

College of Chemistry—Continued.

Bill of James R. McDonald & Co.—Continued.	Marks.
2,000 test tubes, 120x16 mm.	53.00
1,000 test tubes, 120x20 mm.	36.00
40 nests of beakers, 1–10	94.00
8 nests of beakers, 1–12	26.80
66 nests of beakers, 1–8	108.90
10 potash apparatus, No. 145	11.00
10 potash apparatus, No. 146	12.00
10 potash apparatus, No. 148	14.50
20 potash apparatus, No. 141	10.00
5 gas-pipettes, No. 536	7.50
5 gas-pipettes, No. 537	8.50
10 gas-pipettes, No. 539	24.00
1 gas-pipette, No. 542	6.00
5 gas-pipettes, No. 543	15.00
5 gas-pipettes, No. 547	33.00
1 gas-pipette, No. 703 (old catalogue)	5.00
2 Hoffman retorts, bent	9.60
5 condensers, No. 445	15.75
1 condenser, No. 446	3.15
1 condenser, No. 447	4.80
7 nitrogen tubes	2.94
Measuring flasks, without stoppers:	
5 1,000 cc.	4.75
5 500 cc.	3.50
10 250 cc.	5.50
10 200 cc.	4.50
10 25 cc.	2.40
10 20 cc.	2.20
10 10 cc.	1.80
10 5 cc.	1.50
Measuring flasks, with stoppers:	
2 2,000 cc.	3.60
5 500 cc.	4.75
10 250 cc.	8.00
5 125 cc.	2.25
10 100 cc.	4.00
1 eudiometer, 250 mm.	1.95
1 eudiometer, 500 mm.	3.00
5 burettes, with stopcock 25 1–10	10.75
10 burettes, with stopcock 50 1–10	30.00
5 burettes, with stopcock 100 1–5	18.50
3 burettes, with stopcock 150 1–2	11.10
2 burettes, with stopcock 200 1–2	8.20
7 burettes, Rammelsberg's, 50 1–5	14.70
7 burettes, Rammelsberg's, 100 1–5	21.70
2 burettes, Rammelsberg's, 25 1–5	2.20
1 gas-measuring tube, 200 c.cm.	2.40
1 gas-measuring tube, 100 c.cm.	1.95
1 gas-measuring tube, 50 c.cm.	1.50
1 gas-measuring tube, 25 c.cm.	.85
2 measuring pipettes, 1 1–100 c.cm.	.96
2 measuring pipettes, 2 1–50 c.cm.	1.20
2 measuring pipettes, 5 1–20 c.cm	1.40
2 measuring pipettes, 10 1–20 c.cm.	1.60
2 gas-measuring pipettes, 25 1–10 c.cm.	2.00
1 apparatus, 100 gr., No. 58	3.00
1 apparatus, 250 gr., No. 131	1.50
3 apparatus, 250 gr., No. 122	1.50
1 gas wash bottle, 250 gr., No. 554	4.20
2 gas wash bottles, 250 gr., No. 555	2.90
20 Woulff bottles, 125 gr., 2-holes	9.60
1 oxyhydrogen gas apparatus, No. 709 (old catalogue)	5.00
2 oxyhydrogen gas apparatus, No. 59	12.00
2 oxyhydrogen gas apparatus, No. 60	12.00
5 measuring flasks, 200–200 cc.	3.75
5 measuring flasks, 150–160 cc.	3.00
10 measuring flasks, 100–110 cc.	4.80
10 measuring flasks, 150 cc.	3.50
4 measuring flasks, 300 cc.	2.40
4 measuring flasks, with stopper, 1,000 cc.	5.20
100 Bologna flasks	6.00
Chloride of calcium tubes:	
1 8 cm., No. 435	.50
1 10 cm., No. 435	.55

College of Chemistry—Continued.

Bill of James R. McDonald & Co.—Continued.	Marks.	
1 12 cm., No. 435	.65	
1 14 cm., No. 435	.70	
1 16 cm., No. 435	.85	
1 8 cm., No. 436	1.00	
4 10 cm., No. 436	4.40	
6 12 cm., No. 436	7.20	
4 15 cm., No. 436	6.00	
3 burettes, with stopcocks, 100 1–10 c.cm.	12.60	
1 apparatus, No. 82	.80	
1 apparatus, No. 83	.80	
1 Haaröl burette, with stopcock, 500 gr.	5.40	
1 Haaröl burette, with stopcock, 400 gr.	4.80	
1 Haaröl burette, with stopcock, 250 gr.	4.20	
1 Haaröl burette, with stopcock, 200 gr.	3.60	
6 nitrometer tubes, 124	3.00	
7 nitrometer tubes, 125	3.85	
10 nitrometer tubes, 140	6.00	
20 burette floats	11.00	
Homeopathic vials, with stoppers:		
100 60–15 mm. 5 gr.	14.50	
100 50–11 mm. 3 gr.	12.00	
50 70–18 mm. 10 gr.	8.00	
50 80–20 mm. 15 gr.	9.00	
2 tubes, graduated	15.60	
6 prs. gas burettes	50.40	
1 pr. gas burettes, Winkler's pattern	10.20	
1 Hoffman tube	4.30	
1 eudiometer, No. 493	7.80	
1 eudiometer, No. 495	3.60	
2 Hoffman tubes	20.00	
8 Woulff bottles, 2 necks, 500 gr.	6.00	
20 Woulff bottles, 2 necks, 250 gr.	12.00	
1 separating funnel, globe stopped, 2,000 gr.	3.95	
Funnels, Bunsen's form:		
5 40 mm.	.60	
5 50 mm.	.75	
5 60 mm.	.90	
5 70 mm.	.95	
5 80 mm.	1.00	
5 90 mm.	1.02	
5 100 mm.	1.20	
5 120 mm.	1.50	
10 thermometers, with milk glass scales, 100° C.	18.00	
10 thermometers, with milk glass scales, 250° C.	21.50	
30 thermometers, with milk glass scales, 360° C.	72.00	
1 normal thermometer, 100°, 1–10	10.80	
22 nests of beakers, 1–8	36.30	
2 specific gravity bottles, with stoppers, 10 gr.	1.80	
2 specific gravity bottles, with stoppers, 25 gr.	2.20	
2 specific gravity bottles, with stoppers, 50 gr.	3.00	
2 specific gravity bottles, with stoppers, 100 gr.	3.60	
5 specific gravity bottles, with thermometers, 50 gr.	15.00	
3 specific gravity bottles, with thermometers, 100 gr.	10.80	
1 specific gravity bottle, with thermometer, 25 gr.	2.75	
2 cu. in. bottles, 1 cu. in. (English)	.70	
	Mks. 2,045.14	
20% discount	409.02	
	1,636.12	
Total for cases and packing	129.00	
Legalization (consul's) fee, etc.	12.10	
	1,777.22	
2% discount	35.54	
	Mks. 1,741.68	
Freight, cartage, etc.	82.65	
Commission	91.22	
	Mks. 1,915.55	$462 69

College of Chemistry—Continued.

Bill of New York Belting and Packing Co. (Ltd.):		
200 ft. 1½″ cotton rubber-lined hose, coupled complete, with expanding ring screw couplings		$44 00
3 1½″ brass nose pipes		
1 1½x1¼ hose reducers		
1 1½x1 hose reducer		
1 vertical attachment, complete—George Breck		38 70
Bill of John Taylor & Co.:		
6 3″ Battersea roasting dishes	$0 30	
6 4″ Battersea roasting dishes	35	
1 pr. 26″ cupel tongs	60	
2 carboys commercial muriatic acid, 240 lbs.	7 20	
50 lbs. sodium nitrate	1 50	
10 lbs. assayer's granulated lead	1 50	
10 lbs. assayer's sheet lead	1 40	
25 lbs. litharge	1 88	
5 lbs. borax glass, pulverized	1 50	
25 lbs. fire clay	75	
20 lbs. No. 1 bone ash	70	
1 1¼″ brass cupel mould	1 60	
3 doz. A2 Battersea crucibles, Colorado pattern, hard	90	
3 doz. A1 Battersea crucibles, Colorado pattern, hard	1 35	
3 doz. B Battersea crucibles, Colorado pattern, hard	1 20	
1 doz. covers for large size (B) Battersea crucibles	50	
1 doz. Battersea annealing cups	65	
1 muffle for Hoskin's large furnace, 10x6x4	75	
3 doz. 2″ Battersea scorifiers	45	
34 3″ Battersea scorifiers	85	
		25 93
36 ozs. silver sheet—J. Caire Co.		27 00
1 analyst balance and weights—J. Caire Co.		60 00
Bill of Dunham, Carrigan & Hayden Co.:		
1 gross assorted screw-eyes, iron	$0 40	
1 gross assorted screw-hooks, iron	60	
36 iron reducing elbows, ⅜″ to ⅛″	72	
12 ⅜″ black iron elbows	24	
12 ⅜″ black iron tees	24	
1 steel rake	40	
1 garden hoe, 8″ lock	40	
3 doz. No. 9 air-cocks, ⅛″	9 36	
		12 36
17,400 cu. ft. gas—Oakland Gas L. & H. Co.		30 45
12,100 cu. ft. gas—Oakland Gas L. & H. Co.		21 20
Customs charges—C. D. Bunker & Co.		4 00
Expressage—Patterson & Co.		5 50
65 lbs. ice—G. N. Martin		1 45
Shave hook—Dalziel & Moller		35
$5\frac{6}{10}$ lbs. aluminum sheets, No. 8—John Taylor & Co.		3 76
5¼ lbs. aluminum sheets, No. 14—John Taylor & Co.		3 73
14 Mohr's graduated burettes, without tips or clamps—John Taylor & Co.		14 00
3 doz. 6-lb. bots. muriatic acid—John Taylor & Co.		32 40
2 doz. 7-lb. bots. nitric acid—John Taylor & Co.		25 20
1 doz. 9-lb. bots. sulphuric acid—John Taylor & Co.		16 20
72 bots.—John Taylor & Co.		18 00
1 burette, 75%, $\frac{1}{10}$—John Taylor & Co.		1 00
2 doz. pinch cocks, medium—J. Caire Co.		2 20
2 doz. clamps—J. Caire Co.		7 44
16 ozs. iodine—J. Caire Co.		4 75
1 lb. potass. bromide—J. Caire Co.		40
5 lbs. aluminum sheets—J. Caire Co.		3 75
1 doz. hack-saw blades—J. Caire Co.		1 35
1 Wiss shear—J. Caire Co.		1 90
24 sheets asbestos, $\frac{1}{16}$, $\frac{1}{8}$, $\frac{3}{16}$—Miller, Sloss & Scott		13 19
300 sheets cardboard, cut to various sizes—Blake, Moffitt & Towne		13 50
2 bbls. alcohol—Crown Distilleries Co.		50 28
Freight—Meyer, Wilson & Co.		16 39
Freight—Southern Pacific Co.		25
Expressage—Patterson & Co.		14 00
5 gals. raw linseed oil—W. P. Fuller & Co.		2 65
5 gals. turpentine—W. P. Fuller & Co.		2 30
5 lbs. putty—W. P. Fuller & Co.		15
5 pts. LePage glue—W. P. Fuller & Co.		1 75
20 lbs. G. S. zinc paint—W. P. Fuller & Co.		2 00

College of Chemistry—Continued.

1 doz. drawer pulls; 1 surf. pick; 1 keyhole saw and pad; 1 compass saw, 12—Dunham, Carrigan & Hayden Co.	$1 00
1 Stanley plane, No. 45—Miller, Sloss & Scott	5 14
Notary's fee—M. C. Hamlin	50

Bill of James R. McDonald & Co., for goods purchased from Franz Schilling; in marks, total in dollars and cents:

	Marks.
50 St. Rollflaschen m. Deckelstopsel, 750 gr.	39.00
50 St. Rollflaschen m. Deckelstopsel, 500 gr.	21.50
112 St. Präparatengläser m. Hals u Deckel	28.00
1 Kiste and emballage	6.00
40 St. Rollflaschen m. Deckelst, 1,000 gr.	24.80
50 St. Präparatengläser, ohne Hals, 130–50 cm.	28.50
22 St. Präparatengläser, ohne Hals, 160–70 cm.	18.70
1 Kiste and emballage	6.00
10 St. Präparatengläser, ohne Hals, 220–85 mm.	11.00
100 St. Präparatengläser, ohne Hals, 100–30 mm	40.00
10 St. Präparatengläser, mit Hals, 210–65 mm.	8.40
20 St. Präparatengläser, mit Hals, 150–50 mm.	12.00
50 St. Präparatengläser, mit Hals, 100–30 mm.	19.00
1 Kiste and emballage	5.00
10 fraktions kolben, 1,000 gr.	9.00
58 fraktions kolben, 250 gr.	24.36
5 Gaswaschflaschen, 500 gr.	6.00
2 Spritzflaschen, 500 gr.	2.90
20 Homographische glässchen, 20 cm.	5.40
20 Homographische glässchen, 25 cm.	4.00
20 Homographische glässchen, 30 cm.	6.00
1 Grammflasche, 25 cm.	1.10
1 Kohlensäure apparat	2.65
2 Wasserzersetzung apparate	3.80
2 Wasserzersetzung apparate, kleine	3.50
2 Glöckelsen, grosse	1.40
2 Glöckelsen, mittel	1.00
2 Glöckelsen, kleine	.80
1 Luftpumpen regulator	4.80
10 Spechalflaschen, No. 344	6.50
5 Spechalflaschen, No. 345	3.00
1 Satz Glasteile	23.00
1 Kiste and emballage	7.00
80 Satz kochbecher, gewöhnl.	132.00
1 Kiste and emballage	6.00
140 Kochflaschen, 500 gr.	30.10
1 Kiste and emballage	7.00
100 Kochflaschen, 500 gr.	21.50
100 Kolben m. Konisch. Hals, 60 gr.	12.00
1 Kiste and emballage	6.00
5 Kolben m. konisch. hals, 5,000 gr.	9.00
5 Kolben m. konisch. hals, 4,000 gr.	7.20
5 Kolben m. konisch. hals, 3,000 gr.	5.40
50 Kolben m. konisch. hals, 500 gr.	16.25
20 Kolben m. konisch. hals, 200 gr.	3.90
1 Kiste and emballage	7.50
50 fraktions kolben, 50 gr.	10.00
50 fraktions kolben, 500 gr.	30.00
1 Condensations röhre, No. 455	9.60
5 Retorten m. eingeschl. str., 60 gr.	1.20
5 Spritzflaschen, 100 gr.	4.75
1 Kiste and emballage	7.50
2 Apparate n. Hoffmann, No. 184, grad.	20.40
1 Gasburette n. Winkle, No. 520	10.20
1 Thermometer, No. 937	2.65
1 Psychrometer n. August	16.80
5 Chlorcalcium o. cylinder, 25 cm.	3.60
10 Retorten m. 2 Kugeln, 200 gr.	9.50
3 Gaswaschflaschen, 250 gr.	3.90
3 Gaswaschflaschen, 200 gr.	3.60
5 Chlorcalcium cylinder, No. 422	2.75
2 Gaswaschflaschen, 250 gr.	3.40
1 Sicherheits röhre m. 2 Ventilen, No. 841	.80
1 Thermometer m. Stock	9.00
50 Kolben m. graden Hals, 200 gr.	9.75
1 Kiste and emballage	5.00
3 Einsetzkisten and emballage	1.50

College of Chemistry—Continued.

Bill of James R. McDonald & Co.—Continued.	Marks.
100 Kolben m. Konish. Hals, 250 gr.	24.00
80 Kolben m. Konish. Hals, 200 gr.	15.60
1 Kiste and emballage	6.50
5 Retorten m. Tub. and Stöpsel, 4,000 gr.	9.00
5 Retorten m. Tub. and Stöpsel, 3,000 gr.	7.50
5 Retorten m. Tub. and Stöpsel, 2,000 gr.	5.40
50 Kolben m. gradem Hals, 100 gr.	6.50
50 Kolben m. gradem Hals, 60 gr.	6.00
1 Kiste and emballage	9.00
20 Kolben m. konisch. Hals, 1,000 gr.	10.80
10 Kolben m. konisch. Hals, 2,000 gr.	7.80
10 Kolben m. gradem Hals, 1,000 gr.	5.40
5 Kolben m. gradem Hals. 2,000 gr.	3.90
50 Kolben m. gradem Hals, 100 gr.	6.50
1 Kiste and emballage	7.00
100 Kolben m. gradem Hals, 500 gr.	32.50
1 Kiste and emballage	7.00
80 Kolben m. gradem Hals, 500 gr.	26.00
35 Kolben m. konischem. Hals, 100 gr.	4.55
1 Kiste and emballage	6.00
20 Kolben m. gradem Hals, 750 gr.	9.10
50 Kolben m. gradem Hals, 250 gr.	12.00
20 Kolben m. gradem Hals, 500 gr.	6.50
15 Kolben m. konish. Hals, 100 gr.	1.95
100 Erlenmeyer, 60 gr.	9.00
20 Erlenmeyer, 500 gr.	5.30
1 Kiste and emballage	7.00
60 Rollflaschen m. Deckelst, 1,000 gr.	37.20
50 Rollflaschen m. Deckelst, 250 gr.	14.50
1 Kiste and emballage	7.00
5 Apparate n. Kipp, 1,000 gr.	33.00
5 Apparate n. Kipp, 500 gr.	28.50
12 Woulfische flaschen, 500 gr. m. 2 H.	9.00
20 Trockenapparate n. Scheibler, 10 cm.	30.00
1 Kiste and emballage	7.00
40 Kg. Biegröhren, 5-6 mm.	50.00
1 Kiste and emballage	3.00
40 Kg. Biegröhren, 7–8 mm.	50.00
5 Thermometerröhren, runde Oeffnung	8.75
5 Barometerröhren	6.25
1 Kiste and emballage	4.00
30 Satz Kochbecher, gewöhnliche, 1–3	123.00
1 Kiste and emballage	6.00
100 Präparatengläser, 50–25 mm.	30.00
52 Präparatengläser, mit Hals, 80–25 mm.	13.52
37 Präparatengläser, ohne Hals, 85–30 mm.	14.80
2 Mischcylinder, einfach, 1,000 c.cm.	7.20
5 Mischcylinder, einfach, 500 c.cm.	11.50
5 Mischcylinder, einfach, 250 c.cm.	8.75
10 Mischcylinder, einfach, 25 c.cm.	7.50
10 Mischcylinder, einfach, 10 c.cm.	4.80
2 Messcylinder, einfach, 1,000 c.cm.	6.00
2 Messcylinder, einfach, 500 c.cm.	3.10
2 Messcylinder, einfach, 250 c.cm.	2.40
2 Messcylinder, einfach, 50 c.cm	1.20
1 eudiometer, 800 mm.	3.85
100 Erlenmeyer, 60 gr.	9.00
100 Erlenmeyer, 100 gr.	9.00
30 Scheidetrichter, 125 gr.	46.50
1 kiste and emballage	7.00
50 Kochflaschen, 750 gr.	13.75
60 Kochflaschen, 500 gr.	12.90
1 kiste and emballage	7.00
	1,708.13
Less 20% rebate on Mks. 1,560.13	312.03
	Mks. 1,396.10
Legalization fee, etc.	12.10
	1,408.20
Discount	28.16
	Mks. 1,380.04

College of Chemistry—Continued.

Bill of James R. McDonald & Co.—Continued.	Marks.	
Freight, cartage, shipping, etc.	95.85	
Commission	73.79	
	Mks. 1,549.68	$374 32
Bill of Paul Seiler Electrical Works:		
100 No. 6 porcelain insulators	$0 50	
100 No. 4 porcelain insulators	80	
50 No. 23 porcelean insulators	2 00	
300 screws		
5 binding posts No. 3	1 20	
12 binding posts No. 4	2 40	
12 binding posts No. 5	2 40	
6 binding posts No. 7	1 20	
6 binding posts No. 9	96	
6 binding posts No. 10	72	
6 binding posts No. 14	72	
6 binding posts No. 17	45	
		13 35
5 doz. test-tube racks—R. W. Brehm		35 00
Bill of George Breck:		
1 Criterion lantern	$121 50	
1 adjustable rheostat	20 00	
1 D. E. carrier	1 50	
1 rapid slide-changer	12 00	
	$155 00	
Less	15 50	
		139 50
3 No. 1 hook door springs—Dunham, Carrigan & Hayden Co.		1 20
3 prs. strap hinges, 4″, 5″, 6″—Dunham, Carrigan & Hayden Co.		35
200 ft. barbed wire—Dunham, Carrigan & Hayden Co.		60
2 lbs. galv. staples—Dunham, Carrigan & Hayden Co.		10
Customs charges—C. D. Bunker & Co.		8 00
Expressage—Patterson & Co.		2 75
Marine insurance—Balfour, Guthrie & Co.		6 67
9 burettes, 50 cc.—John Taylor & Co.		9 00
1 sheet D. E. paper—Students' Coöp. Ass'n		20
2 yds. tracing paper—Students' Coöp. Ass'n		70
4 yds. wrapping paper—Students' Coöp. Ass'n		05
Bill of Paul Seiler Electrical Works:		
6 16 candle-power 50-volt lamps	$0 78	
3 6 candle-power 50-volt lamps	2 25	
3 3 candle-power 50-volt lamps	2 25	
2 key sockets, 1 wall, 1 removable for each	90	
2 3″ wood box bells	1 20	
4 push buttons	40	
100 ft. No. 6 rubber-covered wire	3 90	
100 ft. No. 8 rubber-covered wire	2 85	
		14 53
12 25-ampere switches—California Electrical Works		14 40
200 ft. incandescent lamp cord, C. C.—California Electrical Works		5 60
600 ft. office wire, No. 18—California Electrical Works		1 32
1,000 ft. annunciator wire, No. 16—California Electrical Works		2 00
2 lbs. iodine—Redington & Co.		7 70
5 lbs. iodide of potash—Redington & Co.		14 25
2 bill books of 1,000 bills each—The Hicks-Judd Co.		6 25
2 order books of 1,000 orders each—The Hicks-Judd Co.		6 25
Bill of T. P. Andrews:		
6 ⅝—⅘ kits	$1 80	
6 ⅜—3¼x4¼ kits	1 80	
6 ⅘—3¼x4¼ kits	1 50	
4 4x5 Premo plate-holders	5 00	
4 ozs. amidol	3 00	
3 ozs. rodinal	75	
2 ozs. metal	1 50	
	$15 35	
Less excess	15	
		15 20
9,400 cu. ft. gas—Oakland Gas L. and H. Co.		16 45
14,800 cu. ft. gas—Oakland Gas L. and H. Co.		25 90
2 lbs. clinch staples—J. Caire Co.		30
3 doz. brass nickel screw drawer knobs—J. Caire Co.		1 20

College of Chemistry—Continued.

1	Enterprise mill, No. 750—J. Caire Co.				$7 50
50	lbs. sulphate iodide—Mack & Co.				1 50
	Gold seal carbon paper—Payot, Upham & Co.				75
	Oath of free entry—M. C. Hamlin				50
420	ft. redwood boards—Taylor & Co.				9 66
96	ft. sugar pine—Taylor & Co.				1 25
¼	lb. 5-ampere fuse wire—California Electrical Works				18
¼	lb. 10-ampere fuse wire—California Electrical Works				15
½	lb. 20-ampere fuse wire—California Electrical Works				30
100	ft. No. 8 copper-covered wire—California Electrical Works				2 69
100	ft. No. 10 copper-covered wire—California Electrical Works				1 62
200	ft. No. 12 copper-covered wire—California Electrical Works				3 10
200	ft. No. 14 copper-covered wire—California Electrical Works				2 28
3	ozs. pure gold, in thick sheets—John Taylor & Co.				63 00
1	doz. books genuine gold leaf—John Taylor & Co.				5 40
2	gross corks, each 4, 5, 6, 7, 8, 9, 10, 11, 12—J. Caire Co.				9 25
6	No. 1 Enterprise cork presses—J. Caire Co.				2 70
6	No. 2 Enterprise cork presses—J. Caire Co.				4 00
1	No. 24 Enterprise fruit press—J. Caire Co.				2 70
1	No. 33 Enterprise ice shredder, tinned—J. Caire Co.				54
	Expressage—Patterson & Co.				4 00
50	large porcelain cleats—Paul Seiler Electrical Works				1 00
40	small porcelain cleats—Paul Seiler Electrical Works				1 00
200	screws—Paul Seiler Electrical Works				75
1	roll tape—Paul Seiler Electrical Works				35
1	No. 2 Porter motor—Paul Seiler Electrical Works				4 00
1	burner pliers—J. Caire Co.				25
1	gas plier, black, 12—J. Caire Co.				75
6	Disston screwdrives—J. Caire Co.				71
4	Spencer screwdrivers—J. Caire Co.				1 20
3	flat-nose pliers, 4½″—Dunham, Carrigan & Hayden Co.				1 02
3	side-cut pliers, 5″ and 6″—Dunham, Carrigan & Hayden Co.				1 23
1	button plier, 8″—Dunham, Carrigan & Hayden Co.				42
1	Billings combination pliers—Dunham, Carrigan & Hayden Co.				1 00
	Customs entry—C. D. Bunker & Co.				4 00
100	ft. block-tin pipe, ⅜″ bore—John Taylor & Co.				6 00
	Expressage—Wells, Fargo & Co.				4 85
4	Yale rim night latches, 3 keys each, all alike—Miller, Sloss & Scott				6 00
3	Yale padlocks, 1½″, for keys alike—Miller, Sloss & Scott				2 85
6	prs. 1″ narrow brass butts—Miller, Sloss & Scott				18
6	prs. 1½″ narrow brass butts—Miller, Sloss & Scott				12
6	prs. 2″ broad brass butts—Miller, Sloss & Scott				30
3	lengths ⅜″ black pipe—Miller, Sloss & Scott				1 26
3	lengths ⅜″ galv. pipe—Miller, Sloss & Scott				1 68
	Bill of W. Watson & Sons:	£	s.	d.	
	Micro-spectroscope	5	17	0	
	Focusing glass and projective eyepiece for photo-micrography, No. 2	2	5	6	
	Kamsden screw micrometer	3	7	6	
	Set of microscopic objects, Nos. 9, 9a, and 16	8	20	0	
	Tin-lined case and packing		6	6	
		19	18	6	
	Charges, New York to London		9	9	
		£20	8	3	100 00
	Charges, San Francisco to New York				1 25
12	doz. Carbutt L.S. plates—T. P. Andrews				5 94
12	doz. 3¼ Seed plates, No. 26—T. P. Andrews				4 86
12	doz. 4x5 Seed plates, No. 26—T. P. Andrews				7 02
2	copies Ostwald's Allgemeinen Chemie., Vol. 2, Part 1—Students' Coöp. Ass'n				14 00
12,300	cu. ft. gas—Oakland Gas L. & H. Co.				21 52
10	W.R. sieves, assorted—John Taylor & Co.				3 00
1	7x28″ grinding plate—John Taylor & Co.				4 75
4	1-qt. copper retorts—John Taylor & Co.				7 00
2	1-qt. copper retorts—John Taylor & Co.				3 50
1	doz. gas fixture hose cocks for ⅜″ pipe—J. Caire Co.				2 50
2	brass globe valves for ⅜″ pipe—J. Caire Co.				40
2	brass angle valves for ⅜″ pipe—J. Caire Co.				40
1	brass angle valve for ½″ pipe—J. Caire Co.				30
1	brass globe valve for ½″ pipe—J. Caire Co.				30
20	lbs. ice—Oakland Ice Co.				20
1	8x10 No. 4 Zeiss anastigmat lens—T. P. Andrews				28 05
18,000	cu. ft. gas—Oakland Gas L. & H. Co.				31 50

College of Chemistry—Continued.

Bill of James R. McDonald & Co. for glassware purchased of F. Schilling; in marks, total in dollars and cents:

	Marks.	
125 Kochflaschen, 750 gr.	34.37	
75 Kochflaschen, 750 gr.	20.62	
22 Kochflaschen, 500 gr.	4.73	
15 Verbrennungsröhren, 60 cm.	5.00	
20 Verbrennungsröhren, 70 cm.	13.00	
4 Verbrennungsröhren, 80 cm.	3.00	
100 Kochflaschen, 500 gr.	21.50	
70 Kochflaschen, 500 gr.	15.05	
5 Retorten m. Stöpsel, 100 gr.	4.10	
3 Gaswaschflaschen, n. D., 150 gr.	3.90	
3 Apparate No. 115 mit Fuss	21.00	
100 Trichter, 25 mm.	6.50	
5 Messkolben	2.75	
1 set araometer mit cylinder	19.20	
1 set araometer ohne aus 7 Spindeln	13.20	
1 set araometer ohne aus 3 Spindeln	3.60	
1 set araometer ohne aus 2 Spindeln	2.40	
1 set araometer für Schwefelsaure	.78	
1 set araometer für Salzsaure	.78	
1 Milchprober	.72	
1 Essigprober	2.40	
1 Niederländ. Vochtincter	1.00	
1 Universan araometer	2.40	
3 Araometer mit Therm.	5.40	
3 Araometer ohne Therm.	.72	
1 Alkoholmeter mit Therm.	1.80	
1 Alkoholmeter	2.40	
1 Alkoholmeter mit 3 Scalen	2.15	
20 Scheider trichter, 250 gr.	42.00	
5 Scheider trichter, 500 gr.	12.00	
2 Scheider trichter, 1,000 gr.	6.00	
3 Exissa. n. Fresenius	6.30	
1 Mischcylinder, 2,000 c.cm.	6.00	
1 Mischcylinder, 1,500 c.cm.	4.80	
10 Mischcylinder, 100 c.cm.	12.00	
10 Mischcylinder, 50 c.cm.	9.00	
1 Messcylinder, 2,000 c.cm.	4.80	
38 Präparatengläser Deckelots, 85–30 mm.	15.20	
52 Präparatengläser Deckelots, 80–25 mm.	13.52	
60 Präparatengläser Deckelots, 100–30 mm.	22.80	
74 Sätze Kochbecher, No. 1–8	122.10	
10 Sätze Kochbecher, No. 1–12	33.50	
10 Sätze Kochbecher, No. 1–10	23.50	
	Mks. 548.03	
20% rebate	109.60	
	438.43	
Verpackungskosten	53.70	
Legalization fee, etc.	12.10	
	504.23	
2% discount	10.09	
	Mks. 494.15	
Freight, etc.	33.15	
Commission	26.37	
	Mks. 553.67	$134 26
Expressage—Wells, Fargo & Co.		2 85
Expressage—Patterson & Co.		3 00
Freight—Southern Pacific Co.		8 55
1 set grate bars—Dow Steam Pump Works		5 00
6 Climax letter files—Le Count Bros.		1 80
3 10x12 letter copybooks—Le Count Bros.		2 70
6 wire files—Le Count Bros.		48
Marine insurance—Balfour, Guthrie & Co.		2 43
24 bots. ammonia, C. P.—Mack & Co.		14 40
2 carboys F. F. F. ammonia—Mack & Co.		12 50
20 lbs. sulph. ammonia—Langley & Michaels Co.		1 50
50 lbs. sulph. copper—Langley & Michaels Co.		2 25

College of Chemistry—Continued.

1 lb. microcosmic salt—Langley & Michaels Co.		$0 95
5 lbs. iodide potass.—Langley & Michaels Co.		14 00
1 lb. iodine—Langley & Michaels Co.		4 00
2 doz. bots. muriatic acid, C. P.—Langley & Michaels Co.		20 60
1 doz. bots. nitric acid—Langley & Michaels Co.		12 00
1 doz. bots. sulphuric acid—Langley & Michaels Co.		14 25
50 lbs. borax—Langley & Michaels Co.		3 00
2 lbs. citrate iron and ammonia—Langley & Michaels Co.		1 34
1 lb. citric acid—Langley & Michaels Co.		41
20 lbs. starch—Langley & Michaels Co.		1 15
25 lbs. hyposulphite soda—Langley & Michaels Co.		62
25 lbs. sulphite soda—Langley & Michaels Co.		1 37
12 gross Boston lantern slides mats—Hirsch & Kahn	$8 64	
3 doz. Seed plates, 6½x8½—Hirsch & Kahn	4 95	
	$13 59	
Less 10%	1 35	
		12 24
Bill of Bausch & Lomb Optical Co.:		
2 extra plate-holders, 6½x8½, for photo-micrographic camera	$6 75	
1 focusing glass for above camera	40	
1 rafter counting plate, with special disc, 11 eye-piece	4 70	
1 objective ⅔", Ser. I.	3 60	
1 Coddington magnifier, No. 345	1 50	
1 Coddington magnifier, No. 355	1 50	
1 aplanatic triplet, ½" focus	3 00	
1 aplanatic triplet, 1" focus	3 00	
1 set micro. objects, 2, 3, 4, 7, 12, 16, 21, 22	6 25	
		30 70
1 No. 4 revolving bookcase, mahogany—C. F. Weber & Co.		22 50
1 Richards & Co.'s new centrifuge, complete—Richards & Co.		20 00
2 extra grad. urine tubes—Richards & Co.		1 50
2 extra grad. blood tubes—Richards & Co.		2 00
4 extra plain urine tubes—Richards & Co.		1 00
1 Lakers lancet—Richards & Co.		1 75
2 cases—Niehaus Bros. Co.		295 00
1 Buthelot's calorimetric bomb, as modified by Mohler—Eimer & Amend.		189 00
1 special thermometer for same—Eimer & Amend		13 00
1 complete set (40) new reagent bottles—Eimer & Amend		5 02
1 complete set 4 oz. new reagent bottles for toxicological analysis—Eimer & Amend		2 76
516 extra new reagent bottles, 4 oz.—Eimer & Amend		61 92
20 lbs. nitrate lead—J. Caire Co.		1 60
50 ft. pure gum tubing, $\frac{3}{16}$"—J. Caire Co.		2 00
50 ft. pure gum tubing, ¼"—J. Caire Co.		2 25
25 ft. pure gum tubing, $\frac{5}{16}$"—J. Caire Co.		1 12
25 ft. pure gum tubing, ⅜"—J. Caire Co.		1 75
50 ft. ⅛" rubber tube—J. Caire Co.		45
50 ft. $\frac{3}{16}$" rubber tube—J. Caire Co.		95
100 ft. ¼" rubber tube, heavy—J. Caire Co.		3 25
100 ft. $\frac{5}{16}$" rubber tube, heavy—J. Caire Co.		4 00
100 ft. ⅜" rubber tube, heavy—J. Caire Co.		4 70
50 ft. ½" rubber tube—J. Caire Co.		3 25
25 ft. ¾" rubber tube—J. Caire Co.		3 10
25 ft. ⅜" rubber tube—J. Caire Co.		3 95
25 ft. 1" rubber tube—J. Caire Co.		4 15
Postage stamps—John McCarthy, P. M.		5 00
1 Hoskin's crucible furnace, No. 2—J. Caire Co.		4 25
99$\frac{3}{10}$ grams. platinum crucibles and cover—J. Caire Co.		51 61
140 grams. platinum foil and wire—J. Caire Co.		70 10
Bill of Eimer & Amend:		
3 carboy stands, No. 9067	$9 00	
Jones' reductor, No. 9245	13 50	
Hempel's desiccator, No. 9100, medium	2 50	
Hempel's desiccator, No. 9100, large	2 75	
Stelling's desiccator, No. 9102	5 50	
4 burrette clamps, Mohr's, No. 9086, small	90	
4 burrette clamps, Mohr's, No. 9086, medium	1 05	
4 burrette clamps, Mohr's, No. 9086, large	1 20	
Lovibund's tintometer, available for both carbon in steel and percentage of ammonia in water	39 00	
Assay balance, E. & A., new short beam, No. 9013, with specially tested set of weights	120 00	
Distilling apparatus, No. 9104	3 50	

College of Chemistry—Continued.

Bill of Eimer & Amend—Continued.		
Novy's culture apparatus, with rubber band and 3 clamps, No. 9099 (*d*)	$5 50	
Novy's apparatus for tubes, No. 9099 (*e*)	2 40	
Specific gravity bottle, No. 9037	4 00	
E. & A. automatic burrette, 50 cc. capacity, graduated to $\frac{1}{10}$, No. 9039	2 60	
Squibbs burrette, 50 cc., $\frac{1}{10}$, No. 9040	4 25	
Squibbs burrette, with all joints ground 25 cc., $\frac{1}{10}$, No. 9042	4 60	
Burette stand, Allihn's double clamp on porcelain base, No. 9048	3 50	
36 Bunsen burners, No. 5809	8 64	
2 gross brass tips that screw in base of burner, through which the gas issues	15 84	
24 iron supports, square base, No. 8212	7 20	
12 iron supports, square base, No. 8213	5 04	
12 iron supports, square base, No. 8215	9 00	
12 iron supports, square base, No. 8216	12 00	
10 lbs. calcium carbide	2 50	
5 lbs. litmus	1 10	
1 lb. cochineal	35	
1 oz. methyl orange	60	
½ oz. tellurium metall.	4 00	
5 lbs. microcosmic salt	3 25	
		$295 27
4,700 cu. ft. gas—Oakland Gas L. & H. Co.		8 23
Bill of Goodyear Rubber Co.:		
50 ft. $\frac{1}{64}$″ white tubing	$0 50	
50 ft. $\frac{1}{16}$″ white tubing	75	
50 ft. $\frac{3}{32}$″ white tubing	87	
1 ½-gal. gas bag	66	
1 1-gal. gas bag	79	
4 ice bags	77	
4 doz. small cement	1 00	
	$5 34	
Less	54	
		4 80
Expressage—Wells, Fargo & Co.		2 75
Freight—Southern Pacific Co.		5 55
Expressage—Patterson & Co.		8 00
Marin insurance—Balfour, Guthrie & Co.		41
1 gross solio paper, 6½x8½—Hirsch & Kahn		4 10
		$4,355 06

APPENDIX No. 9—*College of Civil Engineering.*

Traveling expenses—H. I. Randall	$26 20
Expressage—Patterson & Co.	1 00
Printing 250 circulars—Pacific Press Pub. Co.	2 50
100 cu. ft. gas—Oakland Gas L. & H. Co.	20
1,500 cu. ft. gas—Oakland Gas L. & H. Co.	3 00
1 gross round head brass screws—Pacific Tool and Supply Co.	35
4 ft. brass tubing—Pacific Tool and Supply Co.	50
1 bundle 6 ft. lath, ⅜″—Henry W. Taylor	50
4 bundles 5 ft. lath, ½″—Henry W. Taylor	2 20
2 pieces 1½x12x16 pine—Henry W. Taylor	65
1 doz. hack-saw blades—Dunham, Carrigan & Hayden Co.	75
Level glasses—Dunham, Carrigan & Hayden Co.	40
3 50-ft. steel brazed chains—J. C. Sala	13 50
2 50-ft. steel tape, 100th of foot—J. C. Sala	11 50
1 100-ft. steel tape, 100th of foot—J. C. Sala	11 00
2 Phil. rods, reading 1,000ths—J. C. Sala	28 00
1 bdle. octagon tool steel—Dunham, Carrigan & Hayden Co.	1 60
1 piece band iron, 6 lbs.—Dunham, Carrigan & Hayden Co.	25
9 Hunter's axes, No. 2—Miller, Sloss & Scott	4 41
6 bdls. laths—Henry W. Taylor	3 30
2 yds. turkey red—M. S. Smith & Sons	25
2 lbs. twine—M. S. Smith & Sons	80
1 quire stencil paper—M. S. Smith & Sons	90
5 lbs. round brass rod—Pacific Tool and Supply Co.	1 20
119 hours' labor, excavating earth—Frank Hewitt	23 80
30 hours' labor, excavating earth—Frank Burch	6 00
59 hours' labor, excavating earth—A. H. Johnson	11 80
60 hours' labor, excavating earth—John Ramsay	12 00
10 bbls. white cement—Henry Cowell & Co.	34 00
10 bbls. lime—Henry Cowell & Co.	14 00

College of Civil Engineering—Continued.

1,300 cu. ft. gas—Oakland Gas L. & H. Co.		$2 30
2,100 cu. ft. gas—Oakland Gas L. & H. Co.		4 20
Expressage—Patterson & Co.		6 75
Expressage—Patterson & Co.		1 00
2 locks—Schmidt & Zehner		60
2 prs. brass butts—Schmidt & Zehner		25
1 blank book—Students' Coöp. Ass'n		75
21½ hours' labor—David McCullough		4 30
24 "Common Sense" pulleys—Dunham, Carrigan & Hayden Co.		72
18 pieces painted corrugated iron, 26″x 7′, 106 pieces painted corrugated iron 26″x 8′—Dunham, Carrigan & Hayden Co.		71 22
2 flush bolts, Tuscan bronze—Dunham, Carrigan & Hayden Co.		40
Bill of Miller, Sloss & Scott:		
24 16-lb. sash weights	$4 61	
350 ft. braided sash cord, drab	3 50	
50 lbs. 30d steel-cut nails 50 lbs. 20d steel-cut nails	3 74	
100 lbs. 10d steel-cut nails	3 25	
100 lbs. 8d steel-cut nails	3 35	
100 lbs. 6d steel-cut nails	3 50	
25 lbs. 8d steel-cut finishing nails 25 lbs. 6d steel-cut finishing nails	2 24	
25 lbs. 4d steel-cut finishing nails	1 25	
6 lbs. lead washers	1 50	
15 lbs. galv. roofing nails	90	
130 ft. painted iron ridge cap	14 30	
10 cast-iron L. P. butts, 5″x 5″ figures	2 00	
4 mort. knob-locks, ornamental iron	3 00	
20 sash lifts, Tuscan bronze	80	
10 sash fasteners, iron bronzed	50	
		48 44
Bill of Pacific Lumber Co.:		
2,052 ft. pine	$22 57	
150 ft. redwood	2 10	
3,940 ft. pine, sized	47 29	
2,430 ft. pine, sized	29 11	
1,800 ft. flooring	54 00	
204 ft. pine, sized	2 45	
884 ft. pine, sized	9 72	
1,018 ft. clear pine, S. 4 S.	20 36	
1,500 ft. No. 1 rustic	30 00	
700 ft. beaded redwood	15 40	
2,514 ft. beaded redwood	55 30	
120 ft. clear pine, S. 4 S.	1 58	
200 ft. redwood, No. 1	3 00	
2,787 ft. beaded redwood	61 30	
1,317 ft. surfaced redwood	29 63	
		383 81
4 ft. Hoyt's belting, 6″ 60 ft. Hoyt's belting, 3″ 40 ft. round belting, ¼″ 1 C. I. bush 3x3, 1½ ex. Clot & Meese		31 80
Bill of Buff & Berger:		
1 15″ engineer's leveling instrument and accessories	$100 00	
Fixed statia wires	3 00	
	$103 00	
Discount 10%	10 30	
	$92 70	
1 bot. oil	25	
1 water-proof bag	1 00	
Packing boxes	1 20	
		95 15
10⅙ days' work as carpenter—Geo. H. Brown		30 50
8⅓ days' work as carpenter—Geo. H. Brown		25 00
16 days' work as carpenter—Geo. H. Brown		48 00
24 days' work as carpenter—Lee Mason		60 00
Expressage—Wells, Fargo & Co.		9 75
45 ft. tin, painted both sides—Forderer Cornice Works		4 00
3 files, 9″—Pacific Tool and Supply Co.		45
1 pint benzine—W. P. Fuller & Co.		15
1 pint bath-tub enamel—W. P. Fuller & Co.		60
1 Fairbanks' platform scale, with wheels—Fairbanks, Morse & Co.		35 00

College of Civil Engineering—Continued.

2 Fairbanks' Harvard trip scales—Fairbanks, Morse & Co.		$14 00
4 change cut gears for Reed screw-cutting lathe—Clot & Meese		10 11
22 brass molds—W. T. Garratt & Co.		35 50
1 tapestry lounge—The Schreiber Co.		15 00
40 ft. ⅜″ round Hoyt belting—Parke & Lacy Co.		4 25
1 16x4x1½ wood split pulley—Parke & Lacy Co.		4 80
2 16x6x1½ wood split pulley for T. & L.—Parke & Lacy Co.		7 50
2 16x8x1½ wood pulley, flat—Parke & Lacy Co.		2 75
1 16x12x1½ wood pulley, flat—Parke & Lacy Co.		3 50
1 10x6x1½ wood pulley, flat—Parke & Lacy Co.		1 60
40 ft. ½″ cold-rolled steel shafting—Miller, Sloss & Scott		10 20
15 18″ tom, 1½″ shafting, self-oiling ring hangers—Miller, Sloss & Scott		41 85
Bill of Miller, Sloss & Scott:		
1 Trimo pipe wrench, 18″	$1 98	
2 Williams' best steel oilers No. 12	48	
1 Williams' best steel oiler No. 16	49	
2 Williams' best steel oil fillers No. 19, 1 pint	1 38	
2 doz. plain hardwood file handles	50	
1 doz. Griffins hack-saw blades, 10″, fine	69	
2 doz. jeweler's hardwood small file handles	50	
1 jeweler's size nickeled saw frame	35	
1 doz. jeweler's saw blades, 5″	15	
1 Chicopee hand drill No. 1, with chuck, complete	2 00	
6 Stanley's boxwood rules, No. 60	1 80	
1 doz. Smith's bench hooks No. 2	4 48	
2 bit braces No. 2710, 10″	70	
1 Maydole claw hammer No. 13, adze-eye, bell-face	30	
1 Hunt's broad hatchet, No. 3, 5″ cut	55	
1 doz. H. Disston & Sons' pointing trowels, 5″	2 15	
2 doz. japanned drawer pulls, No. 100, length 2½″	40	
2 doz. japanned drawer pulls, No. 10, length 4″	80	
1 gross iron wood screws, No. 14, round head, blue	49	
1 gross brass wood screws, ¾″, No. 6, round head	35	
1 gross brass wood screws, ⅞″, No. 7, round head	45	
1 gross brass wood screws, 1¼″, No. 8, round head	65	
		21 64
20 days' work as carpenter—George H. Brown		60 00
1 doz. watch glasses 3½″—John Taylor & Co.		1 31
2,900 cu. ft. gas—Oakland Gas L. & H. Co.		5 10
2,800 cu. ft. gas—Oakland Gas L. & H. Co.		4 90
Expressage—Patterson & Co.		7 50
Expressage—Patterson & Co.		3 25
3 ozs. gelatine—Osgood Bros.		10
1½ lbs. glycerine—Osgood Bros.		40
1 qt. Stafford's ink—Student's Coöp. Ass'n		60
2 Mohr's burettes, 100x½—J. Caire Co.		2 50
2 P. S. thermometers, 300° F.—J. Caire Co.		2 00
2 P. S. thermometers, 200° F.—J. Caire Co.		1 55
1 doz. beakers—J. Caire Co.		1 55
Bill of Pacific Tool and Supply Co.:		
2 small counter-shafts (Fig. 2, C. F. Marwedel's Catalogue, p. 151)	$4 00	
1 Brown & Sharp's American standard wire gauge, No. 730, 0 to 36	2 13	
2 Brown & Sharp's micrometer calipers, No. 15	7 90	
1 Starrett's sock joint transfer caliper, 14″ outside	1 88	
6 Yankee outside calipers, solid nut, 6″	3 84	
1 Starrett's screw pitch gauge, No. 5, 26 pitches, 32 to 82	1 06	
1 Armstrong tool holder, No. 1, complete	1 80	
1 Armstrong boring tool, No. 9	3 60	
1 each Standard Tool Co.'s drills, No. 112, shanks ½″ diameter: ½″, $\frac{17}{32}$″, $\frac{9}{16}$″, $\frac{19}{32}$″, ⅝″, $\frac{21}{32}$″, $\frac{11}{16}$″, $\frac{23}{32}$″, ¾″, $\frac{25}{32}$″, $\frac{13}{16}$″, $\frac{27}{32}$″, ⅞″, $\frac{29}{32}$″, $\frac{15}{16}$″, $\frac{31}{32}$″, 1″ (17 drills)	8 57	
1 each Standard Tool Co.'s drills, No. $\frac{1}{5}$, straight shanks: $\frac{1}{16}$″, $\frac{3}{32}$″, ⅛″, $\frac{5}{32}$″, $\frac{3}{16}$″, $\frac{7}{32}$″, ¼″, $\frac{9}{32}$″, $\frac{5}{16}$″, $\frac{11}{32}$″, ⅜″, $\frac{13}{32}$″, $\frac{7}{16}$″, $\frac{15}{32}$″ (14 drills)	1 82	
1 Lightning screw plate set, No. 0, with stock tap wrench and 15 sizes taps, dies, and guides, cutting $\frac{1}{16}$″, $\frac{5}{64}$″, $\frac{3}{32}$″, $\frac{7}{64}$″, ⅛″, $\frac{9}{64}$″, $\frac{5}{32}$″, $\frac{11}{64}$″, $\frac{3}{16}$″, $\frac{13}{16}$″, $\frac{7}{32}$″, $\frac{15}{64}$″, ¼″, $\frac{17}{64}$″, $\frac{9}{32}$	10 30	
1 Lightning No. 0 stock, with handle	75	
1 Lightning No. 0 steel collet	40	
1 Bell centering punch	80	
1 Almond drill chuck No. 1, hold 0 to $\frac{5}{16}$″	4 40	
1 Cushman's geared scroll chuck, 6″, 3-jaw, two sets, Nos. 1 and 2	12 95	
1 each Stubs' pliers, 4″ long, round nose; 4″ half round; 4″ plain; 4″ round; 4″ chain; 6″ plain; 6″ side-cutting; 6″ chain	4 40	
1 each Stubs' broaches, $\frac{5}{16}$″, $\frac{21}{64}$″, $\frac{11}{32}$″, $\frac{3}{8}$″, $\frac{13}{32}$″, $\frac{7}{16}$″, $\frac{1}{2}$″ (7 broaches)	4 25	

College of Civil Engineering—Continued.

Bill of Pacific Tool and Supply Co.—Continued.		
1 each Billings & Spencer's screwdrivers: No. 1, 1-8″x 3″; No. 3, 5-16″x 3″; No. 4, 3-8″x 3″	$0 90	
1 Billings & Spencer's adjustable wrench, 6″, black	80	
1 Billings & Spencer's improved combination pliers, 10″	1 20	
1 hand drill No. 2, single gear, hollow handle, nickel plated, drill up to 1-4″, complete	2 00	
1 40-lb. wrought iron solid box blacksmith's vice	4 75	
1 each Foestner machine auger bits, ⅜″, round shank: ¼″, 5/16″, ⅜″, 7/16″, ½″, 9/16″, ⅝″, 11/16″, ¾″, 13/16″, ⅞″, 15/16″, 1″, 1⅛″, 1¼″ (15 auger bits)	11 75	
1 doz. cast brass butts, fast joint, 2″x 2″	2 10	
1 doz. brass drawer locks, No. 6080; width, 1¾″; from selvedge to center of cylinder, ¾″; ⅞″ wood	2 25	
1 doz. flush sash lifts, side screw holes, No. T486A, Tuscan bronzed	30	
Spring brass wire, as follows:		
1 lb. coil No. 10, English standard gauge	24	
½ lb. coil No. 14, English standard gauge	12	
½ lb. coil No. 16, English standard gauge	12	
½ lb. coil No. 18, English standard gauge	13	
½ lb. coil No. 22, English standard gauge	16	
½ lb. coil No. 24, English standard gauge	18	
30 lbs. 1″ round hard brass rod	5 40	
3 lbs. 5/16″ round hard brass rod	54	
1 lb. ⅛″ round hard brass rod	24	
60 machine bolts, ½″ diam., 3½″ long	95	
150 lag screws, ½″ diam., 6″ long	3 38	
50 lag screws, ½″ diam., 2½″ long	75	
		$106 58
Student labor—H. H. Hirst		12 00
Student labor—L. E. Reynolds		15 00
Student labor—H. H. Hirst		5 00
20 pieces plate glass 15x15, ground—W. P. Fuller & Co.		18 00
1 transit with cloth finished standards Attachments for above transit } Buff & Berger		250 20
Bill of Students' Coöp. Association:		
1 letter press, 10x12	$5 00	
1 letter press brush and brush dish	75	
1 doz. sheets oiled paper, 10x12	35	
2 doz. sheets blotting paper, 10x12	35	
1 qt. bot. Stephen's writing and copying ink combined	45	
50 yds. Columbia blue print paper, 42″ wide	3 20	
		10 10
Expressage—Wells, Fargo & Co.		6 90
Expressage—Patterson & Co.		1 50
1 Brown & Sharp's wire guage—Pacific Tool and Supply Co.		2 13
1 Almond drill chuck—Pacific Tool and Supply Co.		4 40
2 7″ piston rings—Adam Schilling & Sons		2 50
200 key tags—Dunham, Carrigan & Hayden Co.		2 00
1 length self-hardening steel—Pacific Tool and Supply Co.		50
1 steel stamp—Pacific Tool and Supply Co.		1 20
Bill of Niehaus Bros. Co.:		
90 linear ft. redwood moldings, Fig. 1	$10 00	
100 linear ft. redwood moldings, Fig. 2	4 00	
80 linear ft. redwood moldings, Fig. 3	3 50	
80 linear ft. redwood moldings, Fig. 4	1 75	
80 linear ft. redwood moldings, Fig. 5	2 00	
80 linear ft. redwood moldings, Fig. 6	1 00	
90 linear ft. redwood moldings, Fig. 7	1 80	
180 linear ft. redwood moldings, Fig. 8	2 00	
80 linear ft. redwood moldings, Fig. 9	1 00	
80 linear ft. redwood moldings, Fig. 10	3 20	
200 linear ft. redwood moldings, Fig. 11	4 00	
350 linear ft. redwood moldings, Fig. 12	5 50	
180 linear ft. redwood moldings, Fig. 13	2 25	
60 linear ft. redwood moldings, Fig. 14	1 50	
150 linear ft. redwood moldings, Fig. 15	1 50	
40 linear ft. redwood moldings, Fig. 16	2 25	
100 linear ft. redwood moldings, ⅞″, quarter round	50	
10 pieces ⅜″x ⅞″x 16′ parting strips, Oregon pine	1 00	
Glazed sash for 6 windows—3′-6″ wide, 8′ high, 1¾″ thick, each sash 9 lights, 12½″x 14½″ lip rail, sq. head	18 00	
1 transom window, 4′x 2′-10″x 1¾″, 8 lights 11″x 15″	1 00	
1 5-panel stock door, 4′x 8′x1¾″, redwood 1 5-panel stock door, 3′-6″x 8′x 1¾″, redwood 2 5-panel stock doors, 4′-6″x 8′x 1¾″, redwood 1 glazed door, 4′x 8′x 1¾″, 9 lights 12¼″x 19″, redwood	20 00	
		87 75

College of Civil Engineering—Continued.

Bill of Dunham, Carrigan & Hayden Co.:		
1 set hand-cut steel figures, ¼″ Roman	$0 85	
1 Brown & Sharpe's Vernier caliper, No. 686, 12″ long, 2¼″ jaws	21 00	
1 Starrett's adj. jaw cut nippers, No. 1	1 65	
1 jobber's drill gauge	1 75	
1 Champion electric, full-mounted screw plates, set No. 107; plate complete in box, with adj. tap wrench, cutting ¼″–20; 5/16″–18; ⅜″–16; 7/16″–14; ½″–12; ⅝″–11; ¾″–10; ⅞″–9; 1″–8; 1/32″ over size	19 17	
1 Lightning No. 0 holder for lathe use	25	
4 Bailey's wood planes, No. 26, jack, 15″ long, 2″ cutter	3 60	
4 Bailey's wood planes, No. 30, jointer, 22″ long, 2⅜″ cutter	4 80	
4 Bailey's wood planes, No. 35, handle smooth, 9″ long, 2″ cutter	4 00	
4 Bailey's wood planes, No. 9½, excelsior block, 6″ long, 1¾″ cutter	2 40	
1 doz. Stanley's try squares, 8″ long	2 88	
1 Stanley's steel square, No. 1, 2 ft. long	60	
6 Buck Bros.' chisels, No. 36, ¾″	2 90	
6 Buck Bros.' chisels, No. 36, ⅞″	3 05	
1 doz. square hickory mallets, mortised, 6″	2 10	
1 doz. wrought-iron bench screws, movable collar, double thread, wood handles, 1″ diameter	3 60	
1 Maydole claw hammer, No. 11, adz-eye, bell face	40	
2 Henry Disston & Sons' saws, No. 7, 26″ long, cross-cut, 8 points to inch	2 40	
3 pat. iron marking and cutting gauges, No. 60	60	
2 Washita mounted oilstones, 8″	1 00	
1 doz. cast brass flush bolts, with strike plates, No. 60, width ¾″, length 4″	1 20	
Steel wire brass in pound packages, button-head, as follows: 1 lb. ⅞″ long, No. 17; 2 lbs. 1¼″ long, No. 16; 3 lbs. 1½″ long, No. 15; 3 lbs. 1¾″ long, No. 14; 3 lbs. 2″ long, No. 14; 4 lbs. 2½″ long, No. 13; 4 lbs. 3″ long, No. 12; 4 lbs. 3½″ long, No. 11; 4 lbs. 4″ long, No. 10	1 55	
Iron wood-screws, as follows: 2 gross ¾″, No. 8, flat head, bright; 2 gross ⅞″, No. 8, flat head, bright; 2 gross 1″, No. 8, flat head, bright; 2 gross 1″, No. 10, flat head, bright; 2 gross 1¼″, No. 10, flat head, bright; 2 gross 1½″, No. 12, flat head, bright; 1 gross 2″, No. 14, flat head, bright; 1 gross 3″, No. 16, flat head, bright	2 68	
Brass wood-screws, 1 gross of each, as follows: ¾″ No. 6, flathead; ⅞″ No. 7, flathead; 1″ No. 8, flathead; 1¼″ No. 8, flathead; 1½″ No. 9, flathead	2 10	
2 lbs. cherry heat welding compound	30	
Crucible cast-steel wire, English standard gauge, as follows: 10 lbs. No. 6, 10 lbs. No. 8, 5 lbs. No. 10, 5 lbs. No. 12	5 14	
6 ft. Crescent special polished rods, ⅞″ diameter	2 40	
30 lbs. special tool steel, 1″, round	4 50	
30 lbs. machinery steel, 1″, round	1 05	
30 lbs. refined iron, 1″, round	66	
30 lbs. Norway iron, 1″, round	1 13	
35 lbs. refined iron ½″x 1″	77	
10 lbs. ½″ wrought-iron washers	40	
1 doz. upright pulleys, japanned, No. 55, 2″ diameter	40	
3 heavy T hinges, 6″	15	
3 Tuscan bronzed barrel bolts, No. T472A, 4″	30	
1 pr. japanned chest handles, No. 32, 3″ handle	10	
1 gross screw hooks, bright wire, No. 108 1 gross screw eyes, bright wire, No. 211	72	
2 doz. plain cast-iron ventilators, 10″x 12″	5 47	
		$110 02
Expressage—Patterson & Co.		2 75
6 handles—Pierce Hardward Co.		50
1 pencil—Pierce Hardware Co.		10
4½ doz. key blanks—Schmitt & Zehner		1 45
1 5-H.P. 110 V. multi polar shunt-wound motor and pulley, 8″ diam. by 5″ face; speed, 950 revs., with sliding rails, starting-box, and automatic release—Westinghouse Electric and Mfg. Co.		212 00
4,000 cu. ft. gas—Oakland Gas L. & H. Co.		7 00
6,600 cu. ft. gas—Oakland Gas L. & H. Co.		11 55
1 lever—Parke & Lacy Co.		4 75
1 scale—H. S. Crocker Co.		1 00
15 hours labor—P. M. Newhall		3 00
3,700 cu. ft. gas—Oakland Gas L. & H. Co.		6 48
Postage stamps—John McCarthy, P. M.		15 00
6,500 cu. ft. gas—Oakland Gas L. & H. Co.		11 37
Expressage—Patterson & Co.		25

College of Civil Engineering—Continued.

1,600 cu. ft. gas—Oakland Gas L. & H. Co.		$2 80
6 zinc batteries—A. Erlandsen		75
Sal ammoniac—A. Erlandsen		10
Freight—Southern Pacific Co.		1 38
Expressage—Patterson & Co.		3 50
		$2,266 67

APPENDIX NO. 10—*College of Mechanics.*

Bill of E. G. Willyoung & Co.:		
1 Methven screen, 2 slots	$26 25	
1 Methven screen, variable	52 50	
1 Methven carburettor	6 25	
12 standard candles	3 60	
1 ballistic galvanometer, G 62	77 18	
1 resistance set and Wheatstone's bridge, R 7	110 25	
3 "R" resistance boxes, 1-1110 ohms	158 76	
1 "R" 22 resistance box, 1-110 ohms	46 31	
1 M 2 variable standard of self-induction	93 10	
1 R 54 Anthony set and bridge	349 13	
1 R 68 Anthony 100,000 ohm. box	104 74	
	$1,028 07	
7½ %	77 09	
		1,105 16
2½ doz. key blanks—A. Erlandsen		1 85
¾ lbs. H.R. tubing—P. Seiler Electrical Works		65
4 cutouts and fuse—General Electric Co.		2 50
1 I. B. Globe valve, 6—Crane Co.		13 20
1 I. B. Globe valve, 3½—Crane Co.		5 40
1 hor. swing chk. valve, 1¼—Crane Co.		1 95
1 hor. swing chk. valve, 1—Crane Co.		1 35
15 lbs. sq. flax packing—Crane Co.		4 20
5 lbs. asbestos wick—Crane Co.		2 00
5 lbs. cotton wick—Crane Co.		1 25
5 lbs. Italian hemp—Crane Co.		70
200 lbs. iron, ⅜x1½—Dunham, Carrigan & Hayden Co.		4 00
200 lbs. iron, ¼x1½—Dunham, Carrigan & Hayden Co.		4 40
150 lbs. iron, ⅜x1¼—Dunham, Carrigan & Hayden Co.		3 00
150 lbs. iron, ¼x1¼—Dunham, Carrigan & Hayden Co.		3 45
1 Weber milk glass photometer—E. G. Willyoung & Co.		105 00
1 app. for solid angles—E. G. Willyoung & Co.		22 00
7 ½%, as agreed—E. G. Willyoung & Co.		10 00
6 Le Clanche zincs—H. J. Herrick		60
50 lbs. sulphur—W. P. Fuller & Co.		1 25
525 ft. 12 B. & S. U. S. 500 V. wire—General Electric Co.		7 80
537 ft. 14 B. & S. U. S. 500 V. wire—General Electric Co.		5 75
1 keg faultless boiler compound—Ensign & McGuffick		15 00
3 vacuum oil-tanks—Standard Oil Co.		22 50
1 bbl. Capital cylinder oil—Standard Oil Co.		22 28
1 bbl. Renown dynamo oil—Standard Oil Co.		12 87
1 bbl. Atlantic red machine oil—Standard Oil Co.		12 00
125 ft. B. & S. stranded rubber wire—Washburn & Moen Mfg. Co.		24 00
100 ft. 6 S. dbl. crown wire—Washburn & Moen Mfg. Co.		3 80
300 ft. 10 S. dbl. crown wire—Washburn & Moen Mfg. Co.		5 88
2 engineers sets—A. L. Fish		9 60
2 Buckeye snifler valves—A. L. Fish		15 00
1 oil filter, 3½ gals.—Miller, Sloss & Scott		21 00
4 2″ crosses—Miller, Sloss & Scott		84
6 2″ Globe valves—Miller, Sloss & Scott		7 80
4 1½″ Globe valves—Miller, Sloss & Scott		3 44
78 iron castings, off patterns—Oakland Iron Works		40 00
Expressage—Patterson & Co.		3 25
Freight—Southern Pacific Co.		8 75
Freight—Southern Pacific Co.		9 24
Expressage—Patterson & Co.		1 25
3,200 cu. ft. gas—Oakland Gas L. & H. Co.		6 50
Expressage—Patterson & Co.		50
Freight—Southern Pacific Co.		2 15
Expressage—Wells, Fargo & Co.		10 95
600 cu. ft. gas—Oakland Gas L. & H. Co.		1 20
600 cu. ft. gas—Oakland Gas L. & H. Co.		1 35
Freight—Southern Pacific Co.		2 15
Expressage—Patterson & Co.		6 35

College of Mechanics—Continued.

Expressage—Patterson & Co.		$5 75
Expressage—Patterson & Co.		1 65
21 days work as carpenter—Geo. E. Cox		62 25
6 2″ elbows—Pacific Tool and Supply Co.		60
4 2″ unions—Pacific Tool and Supply Co.		50
6 2″ to 1½″ bushings—Pacific Tool and Supply Co.		30
6 2″ to 1¼″ bushings—Pacific Tool and Supply Co.		30
1 "Nipber's Electricity"—J. L. Roland		3 25
1 "Barr Pumping"—J. B. Lippincott Co.		4 00
Postage—J. B. Lippincott Co.		24
"Clark's Building"—Macmillan & Co.		2 25
Postage—Macmillan & Co.		20
1 "Laboratory Notes"—R. C. Carpenter		4 00
Electrical Engineering leaflets, series of 35 issues—Electrical Engineer		5 40
"Formulas in Gearing"—Brown & Sharpe Mfg. Co.		1 60
1 copy "Armature Winding"—Geo. Webb Alexander		7 50
1 copy "Grant's Treatise on Gear"—G. B. Grant		50
1½ tons molding sand—Wainwright & Easton		3 00
5 lbs. sizing glue—Yates & Co.		50
5 gals. turpentine—Yates & Co.		2 30
25¾ hours work—Wm. A. Lynn		5 15
16 hours work—Geo. I. Battelle		3 20
12 ft. ¼ conduit—Thos. Day & Co.		25
1 roll blue print paper—Edw. Denny & Co.		1 50
10-amp. W. E. switch—Berkeley Electric Lighting Co.		1 00
1 roll blue print paper—Sanborn, Vail & Co.		1 45
1 1½″ Crosby pop safety-valve—Tracy, Starkweather & Tracy		5 25
Covering steam pipes and boiler with Manville's perfection sectional—Tracy, Starkweather & Tracy		39 00
1,870 ft. clear pine—Pacific Lumber Co.		46 85
198 ft. sugar pine—Pacific Lumber Co.		12 40
1 No. 101 Bundy return trap—C. C. Moore & Co.		100 00
1 No. 4 Bundy trap receiver—C. C. Moore & Co.		18 00
25 lbs. Santa Cruz glue—Yates & Co.		3 00
3 gals. pure orange shellac—Yates & Co.		8 55
2 hf. pts. French varnish—Yates & Co.		1 40
1 lb. dry vermilion—Yates & Co.		20
6 C. H. brushes—Yates & Co.		60
400 ft. pipe, 1″—Dunham, Carrigan & Hayden Co.		19 00
100 ft. pipe, 2″—Dunham, Carrigan, Hayden & Co.		10 50
100 ft. pipe, 1½″—Dunham, Carrigan & Hayden Co.		7 75
100 ft. pipe, 1¼″—Dunham, Carrigan & Hayden Co.		6 10
100 feet pipe, ¾″—Dunham, Carrigan & Hayden Co.		3 38
6 hdl. awls—Dunham, Carrigan & Hayden Co.		3 00
1 doz. hose clamps, 1″—Dunham, Carrigan & Hayden Co.		76
1 5″ vertical Sweet separator—Edward A. Rix		60 00
Bill of General Electric Co.:		
2 sets arc brushes	$0 55	
1 brush gauge	07	
1 150-amp. sta. switch	22 00	
2 single-pole fuse-holders	3 30	
12 160-amp. fuses	97	
100 pony glass insulators	2 44	
1 lb. ½x¼ H. R. tubing	60	
1 lb. ⅝x⅜ H. R. tubing	60	
1 lb. ¾x½ H. R. tubing	60	
1 lb. 1x¾ H. R. tubing	60	
100 ½x12 hard carbons, cored	2 52	
100 ½x7 hard carbons, solid	2 40	
1 rheostat	33 00	
		69 65
13 framed pictures, all fitted, glass back, and mats—Sanborn, Vail & Co		47 60
25¼ days work as carpenter—George R. Knox		75 75
45¾ hours work as student janitor—W. A. Lynn		9 15
21½ hours work as student janitor—W. A. Lynn		4 30
32 hours clerical work—E. I. Dyer		9 60
Expressage—Wells, Fargo & Co.		1 65
Vols. 1 and 2, Transactions—American Institute of Electric Engineers		3 00
10 lbs. lampblack—W. P. Fuller & Co.		1 00
1 lb. fused cyanide of potass.—W. P. Fuller & Co.		1 65
1 Morse taper reamer, No. 2—Pacific Tool and Supply Co.		2 20
½ gross gauge glasses—Dunham, Carrigan & Hayden Co.		1 00
Brickwork in boiler-room—Whitney & Mara		14 50
Repairing plastering—Whitney & Mara		12 00
18 days work as carpenter—George C. Cox		54 00

College of Mechanics—Continued.

Bill of Pacific Tool and Supply Co.:		
5 lbs. No. 21 B. & S. gauge sheet aluminum	$5 00	
5 lbs. No. 16 B. & S. gauge sheet aluminum	4 25	
5 lbs. No. 12 B. & S. gauge sheet aluminum	4 25	
Railing fittings; all tapped for 1″ pipe, right-hand threads:		
9 floor flanges	81	
9 acorn ornaments	1 08	
8 tees	1 20	
10 tees, side outlet	2 10	
25 lbs. B. & H. white brass	6 50	
6 center gauges	1 20	
1 Stanley odd job	50	
2 10″ lock-joint transfer calipers	3 00	
1 14″ lock-joint transfer calipers	1 90	
1 18″ lock-joint transfer calipers	2 25	
Crescent sheet steel, 1 ft. sq.:		
1 piece $\frac{1}{16}$″	70	
1 piece $\frac{1}{8}$″	1 40	
1 piece $\frac{3}{16}$″	2 10	
1 piece ¼″	2 80	
1 piece ⅓″	50	
		$41 54
600 cu. ft. gas—Oakland Gas L. & H. Co.		1 20
Expressage—Wells, Fargo & Co.		1 00
Expressage—Patterson & Co.		7 75
Expressage—Patterson & Co.		7 25
Freight—Southern Pacific Co.		1 12
61 iron castings—Oakland Ironworks		63 45
21 brass castings—Oakland Ironworks		5 00
15 lbs. silk magnet wire, No. 14—Pierce Hardware Co.		20 25
1 ⅛ lbs. silk magnet wire, No. 30—Pierce Hardware Co.		7 09
2 tons Cardiff coal—Jas. P. Taylor		23 13
7 tons Wellington coal—Jas. P. Taylor		68 90
30 9 E. chloride elements—Pacific Storage Battery Co.		446 38
30 9 E. glass jars—Pacific Storage Battery Co.		
31 bolt connectors—Pacific Storage Battery Co.		
30 9 E. chloride elements—Pacific Storage Battery Co.		446 38
30 9 E. glass jars—Pacific Storage Battery Co.		
31 9 E. bolt connectors—Pacific Storage Battery Co.		
176 hours work as carpenter—G. E. Cox		66 00
Clerical work—E. I. Dyer		15 00
804 ft. pine—Pacific Lumber Co.		9 60
800 ft. redwood boards—Henry W. Taylor		19 75
1,000 ft. No. 2 Oregon pine—Henry W. Taylor		
1,500 ft. T. & G. flooring—Henry W. Taylor		33 00
Bill of Miller, Sloss & Scott:		
Machine screw taps:		
2 No. 14, 20 threads	$0 48	
2 No. 14, 24 threads	48	
2 No. 10, 32 threads	40	
2 No. 8, 32 threads	40	
2 No. 6, 32 threads	40	
2 No. 4, 40 threads	40	
6 Hercules screwdrivers, 4″ blade	1 44	
6 Hercules screwdrivers, 6″ blade	1 80	
1 14″ Stilson wrench	1 75	
1 10″ Stilson wrench	1 30	
1 spring balance, cap. 4 oz. by ¼ oz.	45	
1 spring balance, cap. 25 lbs. by ½ lb.	15	
2 spring balance, cap. 40 lbs. by ½ lb.	50	
2 spring balance, cap. 50 lbs. by 1 lb.	1 20	
Cast-iron pipe fittings: Unions, 5 of each size—2″, 1½″, 1¼″, ¾″, ½″, and ¼″	4 80	
1 set Brown & Sharp's gauge disks	34 90	
1 each Le Count's steel chuck drill holders, Nos. 1, 2, 3	1 50	
3 Le Count's steel dog wrenches	2 10	
3 Hartford Tool Co. holders for inside boring	7 50	
3 doz. 12″ hack-saw blades "Star"	2 10	
1 No. 1 taper reamer, Standard Morse twist drill taper	2 00	
3 ½″ carpenter's bits	75	
3 Grobet No. 4, 6″ taper files	1 35	
1 doz. second cut single cut 12″ files	2 15	
2 single belt punches, H size	60	

College of Mechanics—Continued.

Bill of Miller, Sloss & Scott—Continued.		
5 2″ cast-iron tees	$0 70	
5 2″ 1½″ cast-iron reducers	54	
1 doz. bench dusters, quality D. G. No. 12	8 50	
	$80 64	
Less expressage	50	$80 14
Bill of Richardson & Co. for books:		
	£ s. d.	
1 Hydrostatics, etc.	0 7 4	
Treatise on hydronamics	6 3	
Rational heat motors	4 5	
Treatise on warming buildings	10 11	
Thompson's Polyphase Motors	9 1	
Development and Transmission—Unwin	9 0	
Bolton's Motive Power	5 10	
Snell's Electric Power	7 11	
Weymouth, Drum Armatures	5 8	
Fleming, Electrical Laboratory Notes	11 3	
	£3 19 11	22 06
Expressage—Patterson & Co.		3 00
1 pulley, 26½x7—Clot & Meese		7 50
3 1-light electric brackets—Thos. Day & Co.		3 00
Plating one tube—San Francisco Novelty and Plating Works		20
1 gross screws, 2½x16—Schmitt & Zehner		80
1 cylindrical rubber jar—California Electrical Works		1 75
1 wood pulley, 30x10—Clot & Meese		11 00
Bill of Dunham, Carrigan & Hayden Co.:		
Iron wood screws: 2 gross No. 10, 2¼″ long, round head, blued; 2 gross No. 10, 1¾″ long, round head, blued; 2 gross No. 12, 2″ long, flat head, blued; 3 gross No. 8, 1″ long, flat head; 3 gross No. 6, ⅞″ long, flat head; 3 gross No. 5, ¾″ long, flat head; 3 gross No. 4, ⅝″ long, flat head	$4 10	
Brass machine screws, round head, 1 gross each: No. 14, ½″ long, 24 threads; No. 10, ½″ long, 32 threads; No. 8, ½″ long, 32 threads; No. 6, ½″ long, 32 threads; No. 4, ¼″ long, 40 threads	2 17	
Machine screw taps: 1$\frac{5}{16}$″, 18 threads; 1⅜″, 16 threads	63	
3 double-headed set-screw Billings & Spencer wrenches: ¼″—$\frac{5}{16}$″ 3 double-headed set-screw Billings & Spencer wrenches: ⅜″—$\frac{7}{16}$″	2 19	
2 12″ molder's bellows	1 80	
2 18″ molder's riddles	1 50	
Cast-iron elbows, 10 of each size: 2″, 1½″, 1¼″, ¾″, ½″, ⅜″, ¼″	4 11	
1 oz. hard solder (silver medium)	1 25	
1 lb. spelter, granulated and soft	25	
100 lbs. mild steel, 1½″, round and rough	3 10	
150 lbs. mild steel, 2½″, round and rough	4 65	
1 each of ½″, ¾″, ⅞″ Foestner bits	2 05	
2 P. S. Stubs' hack-saw blades, 12″	90	
2 Grobet No. 4, 12″ handfiles	2 00	
2 Grobet No. 6, 10″ handfiles	1 50	
2 Grobet No. 6, 8″ handfiles	1 00	
		33 20
13 ft. sheet lead, 42″ wide—Crane Company		10 01
29 days work—G. E. Cox		87 00
300 ft. 2-braid weather-proof wire—Washburn Mœn Mfg. Co.		20 43
160 ft. stranded globe cable—Washburn Mœn Mfg. Co		24 32
500 ft. solid globe conductor—Washburn Mœn Mfg. Co.		18 00
10 tons Wellington Coal—James P. Taylor		87 44
6 switches—General Electric Co.		1 80
50 Edison key sockets—General Electric Co.		9 00
12 Edison key receptacles—General Electric Co.		2 40
30 lbs. 12 B. T. D. C. C. magnet wire—General Electric Co.		6 30
5 gals. P. & B. paint—General Electric Co.		6 25
100 glass insulators—General Electric Co.		4 00
100 brackets—General Electric Co.		2 08
50 iron pins—General Electric Co.		5 00
Bill of Pierce Hardware Co.:		
25 lbs. finishing nails, 5d	$1 06	
25 lbs. finishing nails, 6d	1 07	
25 lbs. finishing nails, 8d	1 00	
25 lbs. finishing nails, 10d	94	

College of Mechanics—Continued.

Bill of Pierce Hardware Co.—Continued.			
3 putty knives, cocoa handle		$0 45	
6 planes, 9½″		3 60	
6 iron handle saw and pads		78	
1 Starrett's protector		4 00	
1 back saw, $\frac{4}{24}$		1 75	
1 Morrill pat. saw set		63	
9 Jennings' bits, 4, 5, 6		1 75	
6 Clark's bits, No. 2		5 40	
1 doz. garden valve clamps, ¾		32	
1 tube-cutter		2 00	
100 lbs. machine steel		3 00	
			$27 75
360 lbs. sulphuric acid—John Taylor & Co.			2 16
Expressage—Wells, Fargo & Co.			2 25
Expressage—Patterson & Co.			12 00
24 Le Clanche zincs—California Electrical Works			1 93
24 pkgs. sal. ammoniac—California Electrical Works			1 92
5 gals. star oil—W. P. Fuller & Co.			1 05
5 gals. benzine—W. P. Fuller & Co.			1 05
12 doz. Carbutt L. S. plates—T. P. Andrews			5 94
Expressage—People's Express Co.			75
1 No. 3 8x10 Darlot lens—T. P. Andrews			20 00
2 1-pt. glass funnels—T. P. Andrews			30
1 1-qt. glass funnel—T. P. Andrews			25
1 oz. hydrochinon—T. P. Andrews			35
½ lb. alum—T. P. Andrews			15
12 doz. cover-glasses—T. P. Andrews			3 60
1 8x10 enlarging, reducing, and copying camera—T. P. Andrews			27 00
Sizing, kalsomining, and tinting 3 rooms, and furnishing molding for same—Uhl Bros.			45 00
25 lbs. round brass rod, ½″	Pacific Tool and Supply Co.		12 00
20½ lbs. round brass rod, ⅜″			
14½ lbs. round brass rod, $\frac{5}{16}$″			
15 lbs. round brass rod, ¼″			
Bill of Hirsch & Kahn:			
2 doz. 5x7 crown plates		$2 20	
⅔ gross 5x7 solio paper		2 35	
1 5x8 celluloid tray		70	
1 4x5 celluloid tray		50	
2 5x7 "Perfection" plateholders		2 50	
1 8-oz. graduate		40	
1 4-oz. graduate		30	
1 lb. powdered borax		25	
1 oz. metol Hauff		75	
1 oz. bi-chlor. mercury		20	
1 15 gr. vial chlor. gold		60	
4 oz. acetate lead		20	
			10 95
55¼ hours labor—W. A. Lynn			11 05
1,400 cu. ft. gas, Oakland Gas L. & H. Co.			2 40
2,000 cu. ft. gas, Oakland Gas L. & H. Co.			4 00
500 $\frac{5}{16}$x3 Standard bushings, General Electric Co.			5 55
500 ⅝x4 Standard bushings, General Electric Co.			8 84
1 pr. 6″ Stubbs' S. C. pliers, General Electric Co.			1 00
1 pr. 8″ Stubbs' S. C. pliers, General Electric Co.			2 25
15 brass castings, Oakland Iron Works			2 70
23 iron castings, Oakland Iron Works			4 58
6 drawer locks, Dunham, Carrigan & Hayden Co.			1 25
9 prs. cast-brass butts, Dunham, Carrigan & Hayden Co.			2 16
3 doz. 12″ Griffin hack-saw blades, Dunham, Carrigan & Hayden Co.			2 25
2 prs. hinges, Geo. Webb Alexander			50
1 rim lock, Geo. Webb Alexander			40
1 Yale latch, Osborn Hardware and Tool Co.			1 75
3 lbs. round brass rod, ⅜″, Pacific Tool and Supply Co.			60
2 5x7 print frames, Hirsch & Kahn			1 00
1 5x8 print frame, Hirsch & Kahn			55
2 Yale night latches, Pierce Hardware Co.			3 50
1 plane, Pierce Hardware Co.			25
19.48 tons Welington coal—Jas. P. Taylor			169 33
Expressage—Patterson & Co.			3 75
Expressage—Wells, Fargo & Co.			3 00
1 deep porcelain developing tray 5x8—Wm. O. Bacon			81
1 deep porcelain developing tray 8x10—Wm. O. Bacon			1 13

College of Mechanics—Continued.

1 minim glass graduate—Wm. O. Bacon		$0 15
1 camel's-hair dust brush—Wm. O. Bacon		20
1 5″ diam. mortar and pestle—Wm. O. Bacon		65
1 lb. sulphite sodium crystals—Wm. O. Bacon		17
1 lb. granulated carbonate of potassium—Wm. O. Bacon		35
1 lb. carbonate of soda—Wm. O. Bacon		05
2 ozs. bromide of potassium—Wm. O. Bacon		25
2 lbs. crystal or ground alum—Wm. O. Bacon		25
500 Boston mats—Wm. O. Bacon		2 25
10 lbs. No. 2 Albany compound—Tatum & Bowen		4 00
30 lbs. quicksilver—John Taylor & Co.		16 50
1 Sprengle mercury pump—G. E. Lamont		35 00
2 Crooke's tubes—G. E. Lamont		15 00
4 doz. 5x7 Cramer crown plates—T. P. Andrews		4 40
2 doz. 8x10 Cramer crown plates—T. P. Andrews		4 80
2 5x7 Perfection plate-holders—T. P. Andrews		2 50
3 8x10 Perfection plate-holders—T. P. Andrews		5 55
1 8x10 hard rubber tray—T. P. Andrews		1 15
26 days work as carpenter—Geo. E. Cox		78 00
1 10x10 lantern screen, with patent roller—T. P. Andrews		16 00
1 250 cc. glass graduate—T. P. Andrews		1 00
500 binding strips, black—E. P. Andrews		2 50
4,700 cu. ft. gas—Oakland Gas L. & H. Co.		9 40
Installing power circuit for the distribution of electric power—Berkeley Electric Lighting Co.		521 00
4 iron castings—Oakland Iron Works		3 33
3 gals. P. & B. & S. paint—Paraffine Paint Co.		2 25
2 gals black asphaltum varnish—W. P. Fuller & Co.		1 30
23 days work as carpenter—Geo. E. Cox		69 00
Student laborer—W. A. Lynn		17 15
26 iron castings—Oakland Iron Works		18 86
1 brass casting—Oakland Iron Works		70
78 lbs. iron castings—Oakland Iron Works		2 73
4,400 cu. ft. gas—Oakland Gas L. & H. Co.		8 80
Expressage—Wells, Fargo & Co.		3 55
Expressage—Patterson & Co.		13 00
Freight—Southern Pacific Co.		8 53
Vol. 4, Transactions—American Institute of Electrical Engineers		2 00
4 night latches—Pierce Hardware Co.		6 33
5 lbs. solder, 80-100—Pierce Hardware Co.		75
5 lbs. solder, 90-100—Pierce Hardware Co.		70
50 ft. fishing wire—Thos. Day & Co.		75
17 yds. silk cord—Newman & Levenson		85
1 spool silk—Newman & Levenson		35
1 yd. linen—Taft & Pennoyer		35
1 yd. canvas—Taft & Pennoyer		18
10 pieces tape—Taft & Pennoyer		50
21 rolls linen—Taft & Pennoyer	$1 17	
5 rolls linen—Taft & Pennoyer	32	
5 rolls silk ribbon—Taft & Pennoyer	50	
	$1 99	
Discount	15	
		1 84
7 days work as carpenter—Geo. E. Cox		21 00
1 bbl. Hilton's cement—Foss & McNulty		3 00
10 days work as carpenter—Geo. E. Cox		30 00
1 gal. turpentine, white japan—W. P. Fuller & Co.		1 25
10 gals. boiled linseed oil—W. P. Fuller & Co.		5 50
30¾ hours work as student janitor—Wm. A. Lynn		6 15
Sylvanus Thompson's Electricity and Magnetism—Students' Coöp. Ass'n.		1 25
3 lbs. tissue foil—J. Caire Co.		1 05
2 ozs. sulphide calcium—J. Caire Co.		20
½ sack charcoal—Foss & McNulty		30
2 oil cups, fig. 99—Dunham, Carrigan & Hayden Co.		1 50
1 pr. pliers—Dunham, Carrigan & Hayden Co.		55
1 yd. canvas—Salinger Bros.		25
2 prs. pliers—Osborn Hardware and Tool Co.		1 20
1 gross flat head screws, 2x12—Pierce Hardware Co.		45
1 gross flat head screws, 2¼x16—Pierce Hardware Co.		78
1 gross flat head screws, 2½x16—Pierce Hardware Co.		82
2 scrap albums—M. S. Smith & Sons		2 00
Expressage—Patterson & Co.		1 25
8 tons 510 lbs. coal—J. C. Wilson & Co.		60 88

College of Mechanics—Continued.

2 tons Wellington screenings—Jas. P. Taylor		$11 00
3 doz. butts—Pierce Hardware Co.		66
1 lb. wire brads, 1¾—Pierce Hardware Co.		06
5 lbs. wire brads, 2—Pierce Hardware Co.		30
1 lb. wire brads, 1½—Pierce Hardware Co.		12
1 chaser, each 8, 11, 13, 18; 5 pr.—Pierce Hardware Co.		3 75
1 set planer knives, 32″—Pierce Hardware Co.		3 84
1 doz. mill files, 10″—Pierce Hardware Co.		1 45
1 doz. mill files, 12″—Pierce Hardware Co.		2 05
6 hammers, 13—Pierce Hardware Co.		2 40
3 carpenter's pincers, 6″—Pierce Hardware Co.		60
Bill of Elmer G. Willyoung & Co.:		
1 Methven screen, two slots	$26 25	
1 Methven variable screen	52 50	
1 Methven carburettor	6 25	
12 Standard candles	3 60	
	$88 60	
7½%	6 64	
		95 24
Bill of Elmer G. Willyoung & Co.:		
1 ballistic galvanometer	$77 18	
1 R7 resistance box and bridge	110 25	
3 R21 resistance coils	158 76	
1 R22 resistance set	46 31	
1 variable standard of self-induction	93 10	
1 Anthony set and bridge	349 13	
1 100,000-ohm. box	104 74	
	$939 47	
7½%	70 45	
		1,009 92
2½ doz. key blanks—A. Erlandsen		1 85
¾ lbs. H. R. tubing—Paul Seiler Electrical Works		65
4 cutouts and fuses—General Electric Co.		2 50
1 6″ I. B. globe valve—Crane Co.		13 20
1 3½″ I. B. globe valve—Crane Co.		5 40
1 1¼″ orizontal swing brass check valve—Crane Co.		1 95
1 1″ orizontal swing brass check valve—Crane Co.		1 35
15 lbs. assorted sq. flax packing—Crane Co.		4 20
5 lbs. asbestos wick—Crane Co.		2 00
5 lbs. cotton wick—Crane Co.		1 25
5 lbs. Italian hemp—Crane Co.		70
200 lbs. iron, ⅜x 1½—Dunham, Carrigan & Hayden Co.		4 00
200 lbs. iron, ¼x 1½—Dunham, Carrigan & Hayden Co.		4 40
150 lbs. iron, ⅜x 1¼—Dunham, Carrigan & Hayden Co.		3 00
150 lbs. iron, ¼x 1¼—Dunham, Carrigan & Hayden Co.		3 45
1 Weber mink glass photometer—Elmer G. Willyoung & Co.		105 00
1 app. for solid angles—Elmer G. Willyoung & Co.		22 00
7 ½%, as agreed, Elmer G. Willyoung & Co.		10 53
6 Le Clanche zincs—H. J. Herrick		60
50 lbs. sulphur—W. P. Fuller & Co.		1 25
525 ft. 12 B. & S. 500 V. wire—General Electric Co.		7 80
537 ft. 14 B. & S. 500 V. wire—General Electric Co.		5 75
100 lbs. Faultless boiler compound—Ensign & McGuffick		15 00
3 vacuum oil-tanks—Standard Oil Co.		22 50
1 bbl. "Capital" cylinder oil—Standard Oil Co.		22 28
1 bbl. "Renown" engine oil—Standard Oil Co.		12 87
1 bbl. Atlantic red oil—Standard Oil Co.		12 00
125 ft. B. & S. standard rubber wire—Washburn & Moen Mfg. Co.		24 00
100 ft. B. & S. double crown wire, No. 6—Washburn & Moen Mfg. Co.		3 80
300 ft. B. & S. double crown wire, No. 10—Washburn & Moen Mfg. Co.		5 88
2 engineer's sets—A. L. Fish		9 60
2 Buckeye snifler valves—A. L. Fish		15 00
1 oil filter, 3 ½ gals.—Miller, Sloss & Scott		21 00
4 2″ crosses—Miller, Sloss & Scott		84
6 2″ globe valves—Miller, Sloss & Scott		7 80
4 1½″ globe valves—Miller, Sloss & Scott		3 44
78 iron castings—Oakland Iron Works		40 00
21 days work as carpenter—G. E. Cox		62 25
6 2″ elbows—Pacific Tool and Supply Co.		60
4 2″ unions—Pacific Tool and Supply Co.		50
6 2″ to 1½″ bushings—Pacific Tool and Supply Co.		30
6 2″ to 1¼″ bushings—Pacific Tool and Supply Co.		30

College of Mechanics—Continued.

"Nipler's Electricity"—John L. Roland	$3 25
"Barr Pumping," and postage—J. B. Lippincott & Co.	4 24
"Clark's Building"—Macmillan & Co.	2 45
"Laboratory Notes"—R. C. Carpenter	4 00
Subscription for Electrical Engineering Leaflets—Electrical Engineer	5 40
"Formulas in Gearing"—Brown & Sharpe Mfg. Co.	1 60
"Armature Winding"—Geo. Webb Alexander	7 50
"Grant's Treatise on Gear"—G. B. Grant	50
1½ tons molding sand—Wainwright & Easton	3 00
5 lbs. sizing glue—Yates & Co.	50
5 gals. turpentine—Yates & Co.	2 30
25¾ hours work as student janitor—W. A. Lynn	5 15
16 hours clerical work—Geo. Cattelle	3 20
12 ft. ¼ conduit—Thos. Day & Co.	25
1 roll blue print paper—Edward Denny & Co.	1 50
10-amp. N.E. switch—Berkeley Electric Lighting Co.	1 00
1 roll blue print paper—Sanborn, Vail & Co.	1 45
	$5,540 56

Appendix No. 11—*College of Mining.*

Expressage—Patterson & Co.		$0 25
400 cu. ft. gas—Oakland Gas L. & H. Co.		90
Expressage—Patterson & Co.		1 00
⅓ doz. 3-oz. vials—J. Caire Co.		25
1 brazing blowpipe, No. 6—J. Caire Co.		3 00
1 ribbon—S. F. Typewriter Exchange		1 00
1 copy pad—S. F. Typewriter Exchange		1 00
1 rubber strip—S. F. Typewriter Exchange		10
Overhauling Hammond typewriter—S. F. Typewriter Exchange		4 50
Overhauling Hammond typewriter—S. F. Typewriter Exchange		4 25
2 milligram riders—J. Caire Co.		50
2,100 cu. ft. gas—Oakland Gas L. & H. Co.		4 72
3,300 cu. ft. gas—Oakland Gas L. & H. Co.		7 45
8,300 cu. ft. gas—Oakland Gas L. & H. Co.		16 60
1 hollow shaft, with ball bearings—Geo. A. Faulkner		4 75
9 ft. 2″ pipe—J. M. McNamara		1 40
3 2″ T—J. M. McNamara		40
1 2″ union, 1 2″ nipple—J. M. McNamara		60
1 coil B. & S. D. C. C. magnet wire—Washburn & Moen Mfg. Co.		3 50
3 3″ sewer pipe, 1 3″ Y branch, 1 3″ bend—Barker & Hunter Co.		65
50 lbs. Portland cement—Barker & Hunter Co.		1 00
3 "Doble" point and chisel tongs—Abner Doble Co.		4 40
3 "Doble" drill sharpening hammers—Abner Doble Co.		3 70
1 lb. powdered metallic arsenic—Langley & Michaels Co.		70
Bill of John Taylor & Co:		
12 doz. Denver crucible covers, 2¼″	$4 20	
500 No. 7 Battersea fluxing pots	18 75	
5 lbs. potass. cyanide, in tin	2 90	
300 scorifiers 3″	6 00	
250 scorifiers, 2″	2 50	
100 "J" Battersea crucibles	13 33	
12 French muffles, 12x6x4	9 00	
6 doz. 4″ roasting dishes	4 30	
1 small iron mortar, ¼ qt.	40	
2 lbs. metallic arsenic, Mercks	1 10	
		61 88
10,600 cu. ft. gas, Oakland Gas L. & H. Co.		18 55
9,500 cu. ft. gas, Oakland Gas L. & H. Co.		16 65
Expressage—Patterson & Co.		3 50
20 lbs. wire nails—Dunham, Carrigan & Hayden Co.		80
6 tinner's hammers, 1 lb.—Dunham, Carrigan & Hayden Co.		1 80
1 100-lb. keg assay litharge—J. Caire Co.		7 50
1 bbl. Jersey fire-clay—J. Caire Co.		3 50
12 spatulas, 3″ steel blade—J. Caire Co.		2 75
1 spatula, 12″ blade—J. Caire Co.		1 20
100 Manilla paper bags, 11x7¾—J. Caire Co.		45
100 Manilla paper bags, 8½x6—J. Caire Co.		35
100 Manilla paper bags, 6¾″x4″—J. Caire Co.		25
6 brass 2-gm. weights—J. Caire Co.		70
6 brass 1-gm. weights—J. Caire Co.		60

College of Mining—Continued.

	Bill of Schuster Bros.:		
1	Eureka air-compressor	$35 00	
2	2½″ pressure gauges	14 20	
6	brass air-tank fittings	3 00	
50	ft. air-pressure tubing	8 00	
100	ft. lead pipe, ¼″	8 00	
		$68 20	
	Less 25%	17 05	
		$51 15	
1	galv. iron tank	8 10	
2	extra tight air-cocks	1 50	
			$60 75
417	ft. clear redwood—Pacific Lumber Co.		8 34
	Milling—Pacific Lumber Co.		1 70
	Repairing 4 Becker assay balances—Wm. H. Clark		20 00
	Expressage—Patterson & Co.		75
2	Yale night latches—Dunham, Carrigan & Hayden Co.		3 50
	Expressage—Wells, Fargo & Co.		50
1	galv. boiler and fittings—J. M. McNamara		2 75
7,000	cu. ft. gas—Oakland Gas L. & H. Co.		12 25
12,300	cu. ft. gas—Oakland Gas L. & H. Co.		21 52
	Expressage—Patterson & Co.		5 75
1	keg bicarbonate of soda—J. Caire Co.		3 00
100	litharge—J. Caire Co.		8 00
100	Battersea scorifiers, 2½″—John Taylor & Co.		8 50
50	lbs. gran. assay lead—John Taylor & Co.		6 25
6	7-lb. bots., C. P. nitric acid—John Taylor & Co.		7 80
250	Battersea scorifiers, 2¼″—John Taylor & Co.		2 00
100	Colo. pattern crucibles, A soft—John Taylor & Co.		2 60
100	Colo. pattern crucibles, B soft—John Taylor & Co.		3 60
24	porcelain crucibles, 1¼x1x1⅛—John Taylor & Co.		2 50
10,200	cu. ft. gas—Oakland Gas L. & H. Co.		17 85
	Castings for fitting up 2 special hangers—Oakland Iron Works		2 20
3	4″ pipe cylinders, with flanges and heads—Oakland Iron Works		7 50
6	blank covers—Oakland Iron Works		1 20
	Cartage—Oakland Iron Works		25
11,900	cu. ft. gas—Oakland Gas L. & H. Co.		20 85
1	set packings—H. D. Morris & Co.		30
1	1″ gate valve—E. R. Tutt		1 50
1	doz. ignition tubes—J. Caire Co.		85
	Cutting tubing—G. E. Lamont		50
3½	quires filter paper—J. Caire Co.		1 00
	Bill of J. Caire Co.:		
25	2¼″ scorifiers	$0 38	
175	2½″ scorifiers	2 80	
		$3 18	
	Less	63	
		$2 55	
4	lts. C. P. nitric acid	1 40	
			3 95
1	piece sugar pine—Henry W. Taylor		1 20
	Bill of J. Caire Co.:		
100	lbs. common salt	$0 75	
25	lbs. 12d common cut nails	1 00	
100	crucibles, Battersea G.	7 17	
6	corification molds, 9 holes	4 00	
6	cupel trays, 16 sq. holes	3 60	
12	fire clay tiles for crucible furnace covers, 12x12x2	5 40	
1	Hoskins gasoline blow-pipe, No. 3, with 1-gal. brass tank	21 80	
1	Hoskins gasoline muffle furnace for No. 3 muffle, 10x6x4	12 75	
1	Hoskins gasoline crucible furnace for 4 F crucibles	10 20	
100	strong Manilla sample bags, 11x7¾	45	
100	strong Manilla sample bags, 8½ x 6	35	
100	strong Manilla sample bags, 6¾ x 4	25	
6	doz. test tubes, best medium thick Bohemian glass, 5″ long, ⅝″ diameter	1 25	
1	percolator, long and narrow form, ½ pt.	25	
6	pkgs. Schleicher & Schulls' filter paper, in disks, 15 cm. in diameter and in pkgs. of 100 each	1 38	

College of Mining—Continued.

Bill of J. Caire Co.—Continued.		
1 doz. evap. dishes, flat bottom, 6″ in diameter	$4 00	
5 lbs. acetic acid, U. S. P.	75	
45 lbs. C. P. sulphuric acid, with bottles	7 97	
		$83 32
Bill of John Taylor & Co.:		
1 bbl. bone ash, No. 1 (472 lbs.)	$15 34	
2 doz. French muffles, 12″ long, 6″ wide, 4″ high, air holes not bored	16 00	
3 muffles for crucibles (high sides) 18x11x7¾	6 00	
2 doz. covers for crucibles, Battersea G.	80	
100 crucibles, Battersea H.	7 60	
2 doz. covers for same	80	
50 crucibles, Battersea J.	4 00	
2 doz. covers for same	1 20	
100 lbs. granulated test lead	14 00	
50 lbs. sheet test lead	6 25	
100 lbs. litharge, assayer's	7 00	
250 Battersea scorifiers, 2″	2 00	
6 sample brushes, round, 1½″ diameter, No. 1430	2 12	
3 Dixon graphite crucibles, No. 3	60	
1 case gasoline, 10 gals.	2 20	
2 doz. sticks blowpipe charcoal	70	
1 galv. iron tub, 30″ diam., 8″ deep, for batea	2 50	
Glass boiling flasks, flat bottom, best German glass: 2 doz. each, capacity 1 liter, ½ liter, ¼ liter, 125 cc.	13 10	
18 doz. best thin Bohemian glass test-tubes, 5″ long, ⅝″ diameter	2 88	
Glass rods, length not less than 2 ft., best German glass: ½ lb. each of ⅛″ diameter, ¼″ diameter, 3/16″ diameter	60	
Wedgwood mortars: inside diameter not less than 4½″; height not less than 3½″; thickness not less than ½″	1 20	
2 percolators, long and narrow form, 1 pt., glass	40	
2 percolators, long and narrow form, 4 pts.	75	
1 ream filter paper, white, medium weight, in sheets, 21x17″	3 50	

Rubber stoppers, pure gum:

Doz.	Length.	Dia. small end.	Dia. large end.	
1	1″	½″	¾″	3 30
¾	1″	⅝″	⅞″	
¾	1″	¾″	1″	
½	1″	⅞″	1⅛″	
½	1″	1″	1¼″	
½	1″	1⅛″	1⅜″	
¼	1″	1¼″	1½″	
¼	1″	1½″	1¾″	

Corks, best selected velvet quality, and tapering; length at least 1″:

Gross.	No.	Dia. small end.	
1	1	5/16″	4 00
1	2	⅜″	
1	3	7/16″	
1	4	½″	
¾	5	9/16″	
¾	6	⅝″	
½	7	11/16″	
½	8	¾″	
¼	11	⅞″	
¼	12	15/16″	
¼	14	1″	
¼	18	1¼″	
¼	19	1 5/16″	
¼	20	1⅜″	

1 doz. evaporating dishes, flat bottom, 3¼″ diameter	1 50
Casseroles, best royal Berlin porcelain:	
2, capacity 1 liter	2 00
4, capacity ½ liter	2 60
6, capacity ¼ liter	2 40
2, capacity ⅛ liter	60
Labels: Size 1⅛ x 1½, with red border, in boxes, of quality and number equal to Dennison's; 24 boxes	1 70
50 lbs. roll brimstone	1 50
1 lb. ammonium acetate, C. P., and bottle	1 00
1 lb. magnesium chloride, C. P., and bottle	50
1 lb. metallic sodium, in tin	2 25

College of Mining—Continued.

Bill of John Taylor & Co.—Continued.

4 ozs. metallic potassium, and bottle	$6 40	
2 lbs. carbon bisulphide, and can	25	
1 lb. dry shellac, and box	35	
1 lb. glacial phosphoric acid, and bottle, Mercks	60	
3 lbs. caustic soda, purified from alcohol, in sticks, in 1-lb. bottles	1 95	
10 lbs. sodium sulphite, recrystallized, with bottle	1 80	
10 lbs. carbonate of soda, Mercks, crys. and box	3 50	
28 lbs. nitric acid, absolutely free from chlorine, with bottles (28 lbs. at 15 cts., $4 20; 4 bot. at 25 cts., $1)	5 20	
24 lbs. hydrochloric acid, sp. gr. at least 1.20, with bottles	4 60	
24 lbs. commercial hydrochloric acid, sp. gr. at least 1.16, with bottles	2 40	
28 lbs. ammonia water, U. S. P., sp. gr. 0.9000, with bottles	5 95	
		$167 89

Bill of Pacific Tool and Supply Co.:

Brass machine screws, round heads, 1 gross each—

Size.	Threads.	Length.	
4	36	¼″	$5 08
4	36	½″	
6	32	¼″	
6	32	½″	
6	32	¾″	
8	32	½″	
8	32	¾″	
8	32	1″	
10	24	½″	
10	24	1″	
10	24	1½″	

Brass machine screws, flat heads, otherwise duplicate of the foregoing, one gross of each	5 08	
Diamond D taps, 1 each: 3.48, 4.36, 6.32, 14.20	80	
Lightning screw taps, set B, ¼ taper, 20 threads	25	
Lightning screw taps, ¼ plug, 20 threads	25	
Adamant anvil No. 3, weight 9 lbs.	2 70	
Stubs' twist drill and steel wire gauge, Nos. 1 to 60	1 10	
1 Trimo pipewrench, 10″ long when open, to take a 1″ pipe	1 10	
4 blank face plates, 3″ in diameter for ¾″ hole	80	
3 doz. 2″ light narrow butts, planished	90	
1 improved 2-jawed chuck, with slip jaws and round body, styled D, 4½″	11 20	
2 circular metal saws, 2¾″ diameter, B. & S., 20 gauge, ½″ hole	30	
1 Hartford new center reamer, ⅜″ shank	30	
1 saw arbor, for use in lathe with above circular saws of ½″ hole	1 35	
1 lighting countersink shaft for bit brace	40	
Thumb nut blanks, malleable iron, 2 doz. each: ⅛″, ¼″, ⅜″	75	
Malleable iron plain thumb screws, threaded, Standard threads, 2 doz. each: ⅛″ x ¾″, ¼″ x 1″, ⅜″ x 1½″	2 00	
1 pr. Brombacher's best hand shears, No. 3	1 80	
1 pr. Carew's patent wire cutter, 10″ and two extra jaws for same	2 50	
½ lb. spool copper wire, 1 of each: Nos. 18, 19, 20	75	
Bessemer steel square rods, 2 ft. of each, ½″ diameter, ⅜″ diameter, ½″ diameter	50	
		39 91

Bill of Dunham, Carrigan & Hayden Co.:

Tool steel: Stubs' flat, 6′x1″x⅜″; Stubs' round, 8′x½″; Stubs' round, 8′x¾″	$13 40	
Flat brass: 12′x1/16″x¼″, 12′x1/16″x⅜″, 12′x1/16x″½″, 12′x1/16″x¾″, 12′x1/16″x1″	4 80	
Flat brass: 12′x3/32″x⅝″, 12′x3/32″x¾″, 12′x⅛″x1″, 12′x⅛″x1½″, 12′x⅛″x2″	14 75	
Flat head wood screws, 1 gross of each: No. 3, ½″; No. 3, ¾″; No. 4, ¾″; No. 6, ¾″; No. 6, 1″	1 00	
Flat head wood screws, 1 gross of each: No. 8, 1″; No. 10, 1″; No. 6, 1½″; No. 10, 1½″; No. 8, 2″; No. 10, 2″; No. 12, 2″; No. 10, 2½″; No. 12, 2½″; No. 10, 3″; No. 12, 3″; No. 14, 3″	4 25	
Stubs' wire gauge sized drills, No. 26-30 and No. 46–60	25	
1 B. & S. pocket wrench, 5″ long	50	
2 circular metal saws, 3½′ diam. by 20 gauge, ½″ hole	2 20	
Round brass rods: 10′x⅛″, 10′x3/16″, 10′x¼″, 10′x5/16″, 6′x⅜″, 6′x½″ 6′x⅝″, 4′x¾″, 4′x⅞″, 4′x1″, 2′x1¼″, 2′x1½″, 2′x2″	30 00	
Round brass tubing: 6′x⅛″, 6′x¼″, 4′x¾″, 4′x1″, 2′x1¼″, 2′x1½″	4 00	
Sheet brass, 6 sq. ft. of each: 1/64″ thick, 3/64″ thick, 3/32″ thick, 1/32″ thick, 1/16″ thick, ⅛″ thick	11 00	

College of Mining—Continued.

Bill of Dunham, Carrigan & Hayden Co.—Continued.		
1 1-lb. box barbed blind staples, ⅝″; also, 1 box of ¾″	$0 40	
2 lbs. tinned large-head 10 oz. carpet tacks	80	
2 lbs. each 8 oz. and 10 oz. copper tacks	1 20	
Copper burs, 1 lb. each: Nos. 5, 7, 9, 12	1 00	
1 pr. Hall's patent telegraph pliers, 8″	1 45	
Annealed tinned iron wire: 2 1-lb. coils of each: gauge 16, 20, 18	75	
Cast-iron pipe fittings, 12 of each: Elbows—⅛″, ¼″, ½″; tees—⅛″, ⅜″, ½″; unions—¼″, 1″; bushings—⅜ to 1, ½ to 1, ⅛ to ¼, ⅛ to ¾, ¼ to ¾, ⅜ to ¾, ½ to ¾, ¼ to ½, ⅜ to ½; plugs—½″, socket ⅛″, ½″ socket ¼″, ½″ socket ⅜″; nipples—⅛″, ¼″, ⅜″, ½″, ¾″, 1″	7 25	
Machine bolts, 12 of each: 1½x¼, 2x¼, 3x¼, 4x¼, 5x¼, 6x¼, 2x½, 3x½, 4x½, 5x½, 6x½, 2x⅜, 2½x⅜, 3½x⅜, 4½x⅜, 5½x⅜, 7x⅜, 8x⅜, 7x½, 8x½, 10x½, 12x½	4 00	
Carriage bolts, 12 of each of the sizes named above of machine bolts	3 75	
2 doz. plain file handles, soft wood	60	
3 doz. sledge handles, 36″ long	4 50	
Emery cloth, 12 sheets each: Nos. 2, 2½, 3	90	
Sandpaper, 12 sheets each: Nos. 2, 2½, 3	30	
1 qt. Le Page's liquid glue	75	
1 doz. balls twine, twisted	60	
1 wire twine basket	35	
1 Chicopee hand drill No. 2, $\frac{3}{16}$″ chuck	2 00	
Round Norway iron: 12 ft. of each: ¼″, ⅜″, 1″; square Norway iron, 12 ft. ½″, 6 ft. ⅝″, 6 ft. ¾″; flat Norway iron, 12 ft. of each: ⅛′x1″, ⅛′x¾″	22 40	
2 paint brushes, flat, bristles, 2½″x 3½″; 2 paint brushes, flat, bristles, 2″x 3″; 2 shellac brushes, flat, bristles, 1″x 1½″	$3 00	
Bit stock drills: 1 set $\frac{1}{16}$ to ¼x32ds.; 1 set ¼ to ⅜x16ths	1 30	
50 ft. oak-tanned leather belting, 1″ wide	3 00	
Hathaway's combination gauge	1 75	
50 iron case-hardened set-screws, 1″ long, ⅜″ diam., 16 threads	65	
40 headless set-screws, ¾″ long, ⅜″ diam., 16 threads	1 00	
1 pulley tap, ⅜″ diam., 8″ long, 16 threads	1 00	
Morse's pipe tap, 1 of each: 1¼″ diam., 1½″ diam., 2″ diam.	4 50	
2 doz. spring cotters, ⅛″ diam.	60	
2 jackscrews, bell bottom, complete, with lever and wrought screw, 2″ size, 12″	4 00	
1 Henry Disston & Sons' patent revolving saw set, small size	25	
6 Griffin's patent hack-saw blades, 8″ long	30	
2 cabinet clamps, 2″	50	
Stearns malleable iron clamps, 2 of each: 4″, 3″	3 75	
1 steel tape, 50 ft. long, Chesterman's	5 50	
Iron pillow blocks, 2 of each: diam. of hole—⅜″, ⅝″, ½″, ¾″, 1″	6 50	
		$176 75
Bill of Miller, Sloss & Scott:		
Round head wood-screws, blue, 1 gross each: No. 6, ¾″; No. 8, ¾″; No. 6, 1″; No. 8, 1″; No. 10, 1″; No. 8, 1½″; No. 10, 1½″; No. 8, 2″; No. 10, 2″; No. 12, 2″; No. 10, 2½″; No. 12, 2½″	$3 40	
Twist drills, 1 each: $\frac{3}{16}$, $\frac{9}{32}$, $\frac{11}{32}$, $\frac{3}{8}$, $\frac{13}{32}$, $\frac{15}{32}$, $\frac{17}{32}$, $\frac{9}{16}$, $\frac{19}{32}$, $\frac{21}{32}$	3 49	
1 Trimo pipe wrench, 24″ long, when open to take a 2½″ pipe	2 95	
3 extra Stanwood pipe-cutter wheels, No. 1	45	
2 extra Stanwood pipe-cutter wheels, No. 2	72	
3 doz. 1¼″ light narrow butts, planished, No. 838	45	
Steel carpet tacks, 1 lb. each: 8-oz.; 10-oz.; 12-oz.	60	
Steel wire brads, 1-lb. box of each: ¾x18, ⅞x17, 1x16, 1¼x15	30	
Oval head carriage rivets, 1 lb. of each: ¾″ long, size wire No. 10; 1″ long, size wire No. 10; 1⅛″ long, size wire No. 8; 1¼″ long, size wire No. 8	20	
Keany & Foot files: 2 flat bastard, 8″, No. 1; 2 hand smooth, 8″, No. 3; 2 round bastard, 8″, No. 5; 2 half round bastard, 8″, No. 6; 6 taper saw files, 6″, No. 7; 2 square bastard, 8″, No. 15; 2 half round wood rasps, 10″, No. 18; 2 flat bastard, 5″, No. 1	2 00	
Keany & Foot files: 2 hand smooth, 5″, No. 3; 2 round bastard, 5″, No. 5; 2 half round bastard, 5″, No. 6; 2 square bastard, 5″, No. 15	60	
Spring brass wire, 10 lbs. of each: Nos. 15, 16, 17	5 25	
Copper wire, 10 lbs. of each: Nos. 15, 16, 17	5 25	
Black iron pipe: ¾″ diam., 19¼ ft.; ½″ diam., 56 ft.; ⅜″ diam., 51 ft.; ¼″ diam., 53⅔ ft.; ⅛″ diam., 24 ft.	4 92	
		30 48

College of Mining—Continued.

10,400 cu. ft. gas—Oakland Gas L. & H. Co.	$18 20
1 bbl. mortar—Whitney & Mara	75
1 keg fire brick dust—Whitney & Mara	1 00
Casting and fitting 1 receiver with cast flange—Oakland Iron Works	2 50
Expressage—Patterson & Co.	12 75
1 ⅜″ screw block—Dunham, Carrigan & Hayden Co.	1 00
1 ⅝″ screw block—Dunham, Carrigan & Hayden Co.	1 00
1 ⅞″ screw block—Dunham, Carrigan & Hayden Co.	1 40
	$965 26

APPENDIX No. 12—*Department of Lick Observatory.*

6 half-tone engravings—Union Photo-Engraving Co.	$35 40
1 glass reticle—Fauth & Co.	7 50
1 glass reticle—G. N. Sargmuller	7 50
2 reams paper—H. S. Crocker Co.	2 50
Expressage—Wells, Fargo & Co.	5 50
Money order—Postmaster, San José	1 56
Hauling freight—F. P. Childs	4 83
Freight—Southern Pacific Co.	75
Hauling freight—J. Wandell	3 92
Telegrams—Western Union Tel. Co.	1 91
Hauling—J. Wandell	8 60
Freight—Southern Pacific Co.	2 37
Hauling—J. Wandell	6 32
Hauling—J. Wandell	7 79
Telegram—Western Union Tel. Co.	27
Hauling—J. Wandell	6 43
Hauling—J. Wandell	3 60
1 6″ Willard lens—A. H. Reed	85 00
Express charges, etc.—A. H. Reed	6 80
1 horse blanket—E. S. Holden	3 50
Saddle cloth—E. S. Holden	1 50
Halter and strap—E. S. Holden	2 00
Neck collar and strap—E. S. Holden	1 25
Bridle—E. S. Holden	3 75
Lap robe—E. S. Holden	1 50
Postage stamps—A. L. Colton, P. M.	100 00
4 cords wood—J. Wandell	18 00
Telegrams—Western Union Tel. Co.	97
Expressage—Wells, Fargo & Co.	7 55
Hauling freight—F. P. Childs	7 89
Washing towels—Mrs. Sullivan	3 70
Expressage—Wells, Fargo & Co.	11 70
Hauling freight—F. P. Childs	3 37
3 electros—A. A. Beal & Co.	2 94
Telephone—Sunset Tel. & Tel. Co.	1 50
Telegrams—Western Union Tel. Co.	25
Hauling—J. Wandell	2 16
Board of team—S. W. McCarley	1 00
Repairing wagon—S. W. McCarley	75
6 lbs. lead—John Stock Sons	60
3 sockets—John Stock Sons	40
1 stub and trap—John Stock Sons	1 00
1 socket—John Stock Sons	95
3 lbs. solder, and labor—John Stock Sons	2 05
2 varnish brushes—Farmers' Union	50
1 gal. distilled water—Farmers' Union	30
1 gal. demijohn—Farmers' Union	40
36 boxes—A. Fleishhacker & Co.	1 00
1 light glass—John Stock Sons	1 15
2 lbs. lace leather—John Stock Sons	1 60
1 check valve—John Stock Sons	1 25
Gross seed—Farmers' Union	1 00
Ammonia—Farmers' Union	25
1 can axle-grease—Farmers' Union	10
4 spools annunciator wire—J. A. Roebling's Sons Co.	6 90
12 crowfoot zincs—Paul Seiler Electrical Works	3 36
24 crowfoot coppers—Paul Seiler Electrical Works	2 88
12 lbs. sal ammonia—Paul Seiler Electrical Works	1 60
6 battery jars—Paul Seiler Electrical Works	2 10
6 papers tacks—Farmers' Union	30
1 doz. lantern globes—Farmers' Union	90
Gasoline—Farmers' Union	10
1 scrapbook—E. H. Guppy & Son	1 00

Department of Lick Observatory—Continued.

3 papers tacks—Farmers' Union		$0 15
1 doz. sheets flypaper—Farmers' Union		15
1 cord wood—J. Wandell		4 50
1 doz. sheets blotting paper—Bonestell & Co.		1 00
1 box fasteners—E. H. Guppy & Son		25
20 ft. flax packing—Dunham, Carrigan & Hayden Co.		3 10
4 lights glass—John Stock Sons		1 50
3 lead con.—John Stock Sons		3 00
Labor—John Stock Sons		95
1 doz. picture hooks—John Stock Sons		25
3 pieces stovepipe—Farmers' Union		85
Paper—Farmers' Union		2 09
½ gal. oil—Farmers' Union		65
Dressing—Farmers' Union		25
Twine—Farmers' Union		1 95
Bot. ammonia—Farmers' Union		25
Bill of Yates & Co.:		
700 lbs. white lead	$40 25	
1 bbl. raw linseed oil	32 00	
50 lbs. yellow ochre	75	
1 bbl. Prince's metalic	4 50	
10 gals. copal varnish	6 00	
10 gals. turpentine	4 80	
20 gals. boiled linseed oil	14 40	
300 gals. Starlight oil	66 00	
6 lbs. best O. yellow	1 08	
6 lbs. best green	84	
6 lbs. best red	78	
3 lbs. best Tuscan red	54	
3 sash tools	30	
2 putty knives	40	
10 gals. benzine	2 20	
	$174 84	
Less 2%	3 49	
		171 35
4.19 cords four-foot wood—J. Wandell		18 85
100 gals. dynamo lubricating oil—W. P. Fuller & Co.		30 00
5 doz. Carbutt 8x10 A plates—Hirsch & Kahn		10 80
5 doz. Carbutt 6½x8½ plates—Hirsch & Kahn		7 50
1 32-oz. graduate—Hirsch & Kahn		1 50
3 lbs. hydrochinon—Hirsch & Kahn		13 50
½ lb. citric acid—Hirsch & Kahn		50
7 tons hay—L. Bernal		105 00
8 shades—L. Lion & Sons Co.		7 20
1 tapestry rug—L. Lion & Sons Co.		24 00
1 tapestry rug—L. Lion & Sons Co.		13 45
1 mirror—L. Lion & Sons Co.		4 00
Bill of John Stock Sons:		
30 prs. assorted sizes, wrot. butts	$3 10	
18 prs. assorted sizes, brass butts	1 80	
25 lbs. No. 3 wire nails	1 00	
25 lbs. No. 2½ wire nails	1 00	
15 lbs. No. 2 wire nails	65	
1 keg 8d wire nails	2 60	
1 keg 40d wire nails	2 25	
1 gross screw eyes, assorted	40	
1 gross screw hooks, assorted	40	
2 coils picture wire	25	
2 doz. each, 0, 1, 1½, 2 sandpaper	96	
1 doz. 1 each, assorted sizes	45	
150 sq. ft. wire screen	6 00	
		20 86
100 cap 4to records—Brown & Power		16 60
100 ft. 1½" 3-ply Niagara hose, coupled, with nozzles—Crane Co.		22 00
Rental of telephone—Sunset Tel. & Tel. Co.		35 00
5 doz. 8x10 Carbutt process plates—Hirsch & Kahn		10 80
5 doz. 8x10 Seed's transparency plates—Hirsch & Kahn		10 80
10 doz. 6½x8½ transparency plates—Hirsch & Kahn		15 00
1 multum in parvo dev. lamp—Hirsch & Kahn		6 50
1,600 ft. C. D.—Glenwood Lumber Co.		40 00
300 ft. sugar pine—Glenwood Lumber Co.		30 00
800 ft. C. D.—Glenwood Lumber Co.		20 00
1,400 ft. common redwood—Glenwood Lumber Co.		21 00

Department of Lick Observatory—Continued.

Bill of G. H. Tay Co.:		
100 ft. 2½″ pipe, dipped	$14 50	
150 ft. 2″ pipe, dipped	15 00	
200 ft. 1½″ pipe, dipped	14 00	
250 ft. 1″ pipe, dipped	10 63	
300 ft. ¾″ pipe, dipped	9 75	
2½″ fittings: 6 elbows	96	
2½″ fittings: 6 nipples	66	
2″ fittings: 6 tees	60	
2″ fittings: 6 elbows	48	
2″ fittings: 1 doz. nipples	24	
1½″ fittings: 6 tees	42	
1½″ fittings: 1 doz. elbows	72	
1½″ fittings: 1 doz. nipples	42	
¾″ fittings: 3 doz. tees	90	
¾″ fittings: 3 doz. elbows	81	
¾″ fittings: 3 doz. nipples	63	
¾″ fittings: 2 doz. unions	1 68	
1 doz. ¾″ faucets	4 20	
1 doz. ¾″ gate valves	7 92	
6 1″ faucets	3 90	
6 1″ gate valves	5 10	
3 1½″ gate valves	4 95	
3 2″ gate valves	7 20	
		$105 67
20 doz. 8x10 Seed's plates, No. 27—Hirsch & Kahn		45 60
2 oil stoves—John Stock Sons		14 00
4 half tones—Union Photo-Engraving Co.		23 40
1 half tone—Union Photo-Engraving Co.		8 00
1 piece netting 14′ 6″x 10′ 9″—Neville & Co.		5 75
1 rubber cover 7x7—Neville & Co.		4 00
1 diary—Cambridgeport Diary Co.		4 00
1,000 bill heads—Hicks-Judd Co.		4 00
Care of Regents' rooms—Mrs. Sullivan		2 50
Freight—Southern Pacific Co.		1 00
Hauling freight—J. Wandell		2 74
Telephone messages—Sunset Tel. & Tel. Co.		70
Repairing pumps—D. Wight		3 50
Hauling freight—J. Wandell		1 06
1 gal. distilled water—Farmers' Union		30
Repairing fireplace—F. Gardiser		2 75
Freight—Southern Pacific Co.		45
2 cords wood—J. Wandell		9 00
2,730 lbs. hay—L. Bernal		20 47
6 Globe indexes—Payot, Upham & Co.		3 30
1 doz. Globe transfers—Payot, Upham & Co.		4 20
1,000 envelopes—Payot, Upton & Co.		6 50
4 lbs. sash cord—Farmers' Union		1 24
3½ yds. canvas—Farmers' Union		55
1 piece 12x12-24 Oregon pine—Glenwood Lumber Co.		1 45
10 lbs. rope—Neville & Co.		1 00
Expressage—Wells, Fargo & Co.		14 10
Freight—Southern Pacific Co.		4 48
Freight—Southern Pacific Co.		82
Hauling—F. P. Childs		4 79
Hauling—J. Wandell		20 74
Hauling—J. Wandell		1 26
4 bunches laths—Glenwood Lumber Co.		2 00
1 light glass, 25x30—Farmers' Union		75
1 light glass, 11¾x13⅞—Farmers' Union		15
1 doz. Rochester chimneys—Farmers' Union		1 10
1 bot. ammonia—Farmers' Union		25
1 can axle-grease—Farmers' Union		10
Soap—Farmers' Union		30
Toilet paper—Farmers' Union		1 00
6 mops—Farmers' Union		1 25
2 cuts—Dempster Bros.		2 50
2 cords wood—J. Wandell		9 00
1 Nature—B. Westermann & Co.		15
6 blank books—Brown & Power		1 20
2 door checks—John Stock Sons		5 00
7.75 cords wood—J. Wandell		34 87
Hauling lumber—L. Bernal		34 34
Comptes Rendus, Vol. 118—B. Westermann & Co.		28
Telegrams—Western Union Tel. Co.		4 45

Department of Lick Observatory—Continued.

60 ft. packing flax—Dunham, Carrigan & Hayden Co.		$4 50
3½ lbs. twine—Neville & Co.		1 00
4 yds. canvas—Farmers' Union		60
1 T. W. ribbon—Brown & Power		1 00
4 No. 12 casters—Dunham, Carrigan & Hayden Co.		4 00
1 Globe index—Payot, Upham & Co.		30
2.87 cords wood—J. Wandell		12 91
Expenses of U. S. Asst. Appraiser and Inspector of Customs to San José to examine telescope, etc.—C. D. Bunker & Co.		7 00
Bill of Hicks-Judd Co. for binding:		
6 8vos, cloth	$3 90	
2 4tos, cloth	1 80	
4 8vos, half W. G.	3 40	
1 4to, half W. G.	1 10	
13 8vos, half roan	8 45	
9 4tos, half roan	8 10	
1 small folio	1 55	
1 4to, half mor.	1 35	
	$29 65	
Less	10	29 55
5$\frac{12}{100}$ cords four-foot wood—J. Wandell		23 04
Freight—Southern Pacific Co.		76
Repairing telephone line—L. Bernal		1 00
Hauling freight—J. Wandell		2 98
Hauling freight—J. Wandell		10 58
10 lbs. Manilla rope—Neville & Co.		70
50 lbs. 3″ Manilla rope—Neville & Co.		4 50
1 tin sign—L. Lieber		2 50
1 ream paper, 24x36—Bonestell & Co.		3 80
1 gross screw eyes—Farmers' Union		50
1 gal. distilled water—Farmers' Union		30
6 assorted jig saws—Mangrum & Otter		60
6 Cramer brown plates, 11x14—Taber Photographic Co.		2 50
Money order—Postmaster, San José		1 40
Telephone message—Sunset Tel. & Tel. Co.		35
4 doz. paper boxes—A. Fleishhacker & Co.		5 00
1 light glass—California Art-Glass, Blending, and Cutting Works		1 50
Freight—Southern Pacific Co.		3 42
Hauling freight—J. Wandell		6 32
Freight—Southern Pacific Co.		25
Hauling freight—J. Wandell		64
2 paint brushes—Farmers' Union		2 70
Toilet soap—Farmers' Union		50
5 sacks barley—E. S. Holden		2 96
University of California Magazine		1 50
2 cords four-foot wood—J. Wandell		9 00
8 doz. 4x5 Seed's plates No. 27—Hirsch & Kahn		4 95
2 doz. 8x10 Seed's plates No. 27—Hirsch & Kahn		4 55
1 G. S. reader—Hirsch & Kahn		1 00
1 G. S. reader—Hirsch & Kahn		1 03
2 negative racks—Hirsch & Kahn		80
1 negative rack, 11x14 (shop-worn)—Hirsch & Kahn		50
2 8x10 Blair feather weight holders—Hirsch & Kahn		3 70
Expense of Inspector and Appraiser—C. D. Bunker & Co.		7 00
Expressage—Southern Pacific Co.		25
Hauling freight—F. H. Ross & Sons		10
Expressage—Wells, Fargo & Co.		12 70
Telegrams—Western Union Tel. Co.		15 49
Hauling freight—F. P. Childs		7 23
Hauling freight—F. P. Childs		1 34
2 cords four-foot wood—J. Wandell		9 00
Hauling freight—L. Bernal		37 62
6 qts. Carter's ink—Brown & Power		3 00
6 bots. water-proof ink—Brown & Power		1 50
6 small bots. red ink—Brown & Power		50
1 gross assorted pens—Brown & Power		1 00
1 doz. assorted pyramids pins—Brown & Power		1 00
7 boxes fasteners—Brown & Power		1 25
2 doz. small penholders—Brown & Power		50
1 doz. Faber's blue pencils—Brown & Power		75
2 bots. mucilage—Brown & Power		1 00
Cleaning and adjusting clocks—F. H. McConnell		20 00

Department of Lick Observatory—Continued.

1 doz. 11x14 Seed's plates—Hirsch, Kahn & Co.	$4 50
5 doz. 6½x8½ Carbutt's A plates—Hirsch, Kahn & Co.	7 50
6 Seed's plates, 11x14—Hirsch, Kahn & Co.	2 25
Hauling parts of Crossley dome—L. Bernal	188 13
50 gals. raw linseed oil—W. P. Fuller & Co.	22 50
6 11x14 Seed's plates—Taber Photographic Co.	2 50
100 ft. ½″ oak molding—D. Rinaldo	4 00
20 ft. 1″ oak molding—D. Rinaldo	1 00
1 doz. negative boxes—A. Fleishhacker & Co.	1 25
40 pieces 8x13 carbon paper—H. S. Crocker Co.	1 00
5 lbs. 24 B. C. twine—Farmers' Union	1 00
5 lbs. 18 B. C. twine—Farmers' Union	1 00
6 lamp shades—Farmers' Union	1 50
1 bottle ammonia—Farmers' Union	25
1 broom—Farmers' Union	60
1 invoice file—E. H. Guppy & Son	1 50
1 photo album—H. S. Crocker Co.	2 00
Hauling freight—J. Wandell	34
Telephone message—Sunset Tel. & Tel Co.	30
1 "Engineering," No. 1488—B. Westermann & Co.	15
1 "Knowledge," August, 1894—B. Westermann & Co.	15
1 24″ circular cut saw—Pacific Saw Mfg. Co.	12 00
10 doz. 8x10 Seed's plates, No. 27—Hirsch & Kahn	21 60
8 lbs. Mercks' C. P. carbonate of soda—Hirsch & Kahn	4 80
10 doz. Seed's transparency plates, 6½x8½—Hirsch & Kahn	15 00
2 doz. 8x10 Carbutt A plates—Hirsch & Kahn	4 30
4 doz. 11x14 Seed's plates, No. 27—Hirsch & Kahn	18 00
2 doz. 8x10 Carbutt A plates—Hirsch & Kahn	4 30
5 doz. 8x10 Seed's transparency plates—Hirsch & Kahn	10 80
2 doz. 6½x8½ Seed's transparency plates—Hirsch & Kahn	2 97
6 lights plain glass—Farmers' Union	12 00
4 lights glass, 10½″x4″—Farmers' Union	7 00
Delivering 9.86 cords wood—J. Wandell	44 37
Delivering 4 cords wood—J. Wandell	18 00
29 lbs. zinc—Mangrum & Otter	2 90
1 gross screw eyes, No. 114; ½ gross hooks and eyes, 3″; ½ gross hooks and eyes, 4″	2 00
34 lights glass, assorted sizes—W. P. Fuller & Co.	14 50
30 dozen 8x10 cross-ruled pads—Brown & Power	27 00
30 dozen 5x8 plain-ruled pads—Brown & Power	14 40
1 Astronom. Nachrichten, Vols. 139, 150—B. Westermann & Co.	8 00
1 tin, 16x20—Glenwood Lumber Co.	7 20
1 Dow steam plunger pump—Dow Steam Pump Works	290 00
1 circle with verniers, and graduated—The A. Leitz Co.	15 00
2 dozen 8x10 Seed's plates, No. 27—Hirsch & Kahn	4 32
8 dozen 6½x8½ Seed's transparency plates—Hirsch & Kahn	11 88
5 dozen 8x10 Eastman's transparency plates—Hirsch & Kahn	15 30
Repairs to stage-wagon—A. Greeninger & Son	4 25
Freight—Southern Pacific Co.	2 18
Hotel Board—Hotel Metropole	7 00
Traveling expenses—E. S. Holden	1 25
Typewriting—A. E. Hope	2 00
Hauling freight—J. Wandell	8 98
1 electro—C. A. Murdock & Co.	1 45
19½ lbs. putty—The Farmers' Union	68
Cotton batting—The Farmers' Union	1 00
Ammonia—The Farmers' Union	25
1 light glass, 15x20—California Art-Glass, Bending, and Cutting Works	1 50
Freight—Southern Pacific Co.	52
Hauling freight—F. P. Childs	2 61
Expressage—Wells, Fargo & Co.	6 00
Telegrams—Western Union Tel. Co.	1 35
Hauling freight—F. H. Ross & Sons	67
Freight—Southern Pacific Co.	25
Hauling freight—J. Wandell	2 04
Ammonia—C. E. Case	25
Nit. silver—C. E. Case	1 25
Salts—C. E. Case	25
1 gal. distilled water—Farmers' Union	35
4 pulleys—John Stock Sons	40
Soap—Farmers' Union	50
6 burners—Farmers' Union	60
Repairing burners—Farmers' Union	20
1 can chloride of lime—Farmers' Union	25

Department of Lick Observatory—Continued.

2 brushes—Farmers' Union	$2 50
1 light glass, 22¼x30—J. P. Jarman	90
6 10″ files—Mangrum & Otter	1 20
2 brushes—Farmers' Union	2 00
5 lbs. litharge—Farmers' Union	45
Freight—Southern Pacific Co.	25
Hauling freight, etc.—J. Wandell	1 44
Hauling freight, etc.—F. H. Ross & Sons	99
Hauling freight—F. P. Childs	5 92
Expressage—Wells, Fargo & Co.	6 00
Freight—Southern Pacific Co.	6 11
Customs charges—C. D. Bunker & Co.	12 00
Hauling freight—J. Wandell	1 46
Freight—Southern Pacific Co.	50
4 doz. negative cases—A. Fleishhacker & Co.	3 00
Expressage—Wells, Fargo & Co.	12 20
Hauling—F. P. Childs	6 18
Paraffine matches—Farmers' Union	1 00
2 scrap books—H. S. Crocker Co.	2 00
1 stock and die—Dunham, Carrigan & Hayden Co.	2 00
8 machine taps—Dunham, Carrigan & Hayden Co.	2 40
Postage—Dunham, Carrigan & Hayden Co.	15
1 gross shoulder screws—Mangrum & Otter	1 20
2 yds. green duck—L. Lion & Sons Co.	80
2 doz. brass bolts—Mangrum & Otter	3 60
12 lbs. flax twine—Farmers' Union	2 40
Can axle-grease—Farmers' Union	10
2 and 8 oz. sacks—Farmers' Union	50
3 cans lye—Farmers' Union	25
5 gals. turpentine—Farmers' Union	2 75
2 calender pads—E. H. Guppy & Son	70
1 ream 24x36 Manilla paper—Bonestell & Co.	3 60
Freight—Southern Pacific Co.	25
4 cords wood, delivered—J. Wandell	18 00
Postage stamps—A. L. Colton, P. M.	60 00
40th number of L'Astronomie—B. Westermann & Co.	10 00
½ lb. pyro—Hirsch & Kahn	2 25
8 doz. 4x5 Seed's plates, No. 27—Hirsch & Kahn	4 95
20 doz. 8x10 Seed's plates, No. 27—Hirsch & Kahn	43 20
5 doz. 8x10 Seed's transparency plates—Hirsch & Kahn	10 80
Postage on ½ lb. pyro—Hirsch & Kahn	17
12 jars, 12 crowfoot zincs, 12 crowfoot coppers—Paul Seiler Electrical Works	10 80
4 cu. yds. sand, delivered—J. R. Kincaid	16 00
Cutting and hauling 4.48 cords wood—J. Wandell	20 16
2 line engravings—Bolton & Strong	3 00
6 bronzed locks—Mangrum & Otter	50
6 drawer pulls—Mangrum & Otter	25
1 4″ lead P trap—Mangrum & Otter	1 65
1 ft. 4″ lead pipe—Mangrum & Otter	45
4,975 Manilla envelopes—Blake, Moffitt & Towne	17 75
Solder—Mangrum & Otter	25
2 lbs. sheet lead—Mangrum & Otter	70
Labor, cutting, etc.—Mangrum & Otter	25
1 gal. distilled water—Farmers' Union	25
Telegrams—Western Union Tel. Co.	6 23
Expressage—Wells, Fargo & Co.	1 90
Hauling freight, and express—F. P. Childs	1 14
Repairing boiler—D. Wight	1 25
Telephone message—Sunset Tel. & Tel. Co.	40
5 gals. turpentine—Farmers' Union	2 75
24 lbs. putty—Farmers' Union	84
Washing towels—Annie Kellegher	2 65
5 doz. Seed's lantern slide plates—Hirsch & Kahn	2 48
8 days work of one horse—J. Wandell	4 00
2 cords wood, delivered—J. Wandell	9 00
3 cords wood, delivered—J. Wandell	13 50
30 sq. ft. boiler felt—Mangrum & Otter	3 00
Washing L. O. towels, etc.—Mrs. R. Sullivan	6 90
Repairing wagon—Rosat & Verdier	2 25
2 quires buff blotting—Bonestell & Co.	2 80
10 yds. cheesecloth—Farmers' Union	80
5 lbs. glue—Farmers' Union	60
1 doz. 10″ hack-saws—Mangrum & Otter	80
Blacksmithing—R. A. Carroll	15 00

Department of Lick Observatory—Continued.

2½″ black nipples—Mangrum & Otter		$1 25
Ivory soap—Farmers' Union		50
Toilet paper—Farmers' Union		50
60 negative cases—A. Fleishhacker & Co.		5 00
4 Adams brushes—Farmers' Union		5 00
1 fork—Farmers' Union		50
1 can axle-grease—Farmers' Union		10
21 lbs. putty—Farmers' Union		74
1 dandy brush—Farmers' Union		50
3 gals. japan varnish—Farmers' Union		3 60
6 Rochester chimneys—Farmers' Union		60
½ lb. sulphuric acid—Farmers' Union		20
10 lbs. coach black—Farmers' Union		2 50
12 lbs. putty—Farmers' Union		42
1 gal. japan—Farmers' Union		1 40
1 pt. ammonia—Farmers' Union		25
4 tires set—Rosat & Verdier		3 00
The Century Cyclopedia of Names—The Century Co.		13 00
Bill of Edward Stanford:	s. d.	
Kempe's How to Draw a Straight Line	1 6	
Stoke's on Light	7 6	
Mayer & Barnard's Light	2 6	
Polarization of Light	3 6	
Modern Views of Electricity, Lodge	6 6	
A Century of Electricity	4 6	
Chemistry of Photography	6 0	
Postage	3 0	
	£1 15 0	8 52
Expense of sending machinist to Mount Hamilton to repair pump—Dow Steam Pump Works		2 00
Expense of sending machinist to Mount Hamilton to repair pump—Dow Steam Pump Works		6 50
Expressage—Patterson & Co.		1 25
1 lot paper—H. S. Crocker Co.		2 00
1 lot cardboard—H. S. Crocker Co.		1 00
2 ½-gal. bots. Eureka paste—Hirsch & Kahn		2 00
Telegram—Western Union Tel. Co.		55
Freight—Southern Pacific Co.		50
Hauling freight—J. Wandell		1 12
1 pkg. Vulcan tape—Mangum & Otter		75
1 reel insulated wire—Mangum & Otter		2 65
1 sheet zinc, 6′x3′		1 40
6 doz. Carbutt lantern plates—Farmers' Union		3 30
Freight—Southern Pacific Co.		2 63
Hauling freight—J. Wandell		4 04
Hauling freight—F. P. Childs		3 69
Expressage—Wells, Fargo & Co.		9 35
1 cord four-foot wood—J. Wandell		4 50
1 cord four-foot wood—J. Wandell		4 50
Dues, 1896—Astronomical Society of the Pacific		5 00
Repairing typewriter—G. G. Wickson & Co.		8 00
2 doz. 11 x 14 Seed's plates—Hirsch & Kahn	$10 00	
3 doz. 11 x 14 Seed's transparency plates—Hirsch & Kahn	15 00	
3 doz. 14 x 17 Seed's transparency plates—Hirsch & Kahn	27 00	
1 doz 11 x 14 Carbutt B plates—Hirsch & Kahn	5 00	
1 doz. 14 x 17 Carbutt B plates—Hirsch & Kahn	9 00	
	$66 00	
Less 10%	6 60	
		59 40
5 varions—Bolton & Strong		27 00
38 pieces ash—Glenwood Lumber Co.		24 30
300 ft. T. & G. pine—Glenwood Lumber Co.		9 00
10,000 letterheads—C. A. Murdock & Co.		18 00
5,000 letterheads—C. A. Murdock & Co.		14 00
1 Observatory, 1896—Lemcke & Buechner		3 50
1 Nature, 1896—Lemcke & Buechner		6 00
Annals of Mathematics, 1896—Lemcke & Buechner		2 00
Astronomical Journal, XVI—Lemcke & Buechner		5 50
Bulletin Astronomique, 1896—Lemcke & Buechner		4 50
24 boxes—A. Fleishhacker & Co.		1 32
5 doz. boxes—A. Fleishhacker & Co.		18 75

Department of Lick Observatory—Continued.

Bill of Hicks-Judd Co. for binding:		
12 8vos, half roan	$7 80	
2 12mos, half roan	70	
1 4to, half mor.	1 35	
1 4to, half mor.	1 35	
1 4to, half W. G. buff	1 10	
1 8vo, half W. G. buff	85	
1 8vo, cloth	65	
3 small folios	4 50	
2 small folios, half roan	3 10	
15 4tos, half roan	13 50	
		$34 90
62½ lbs. red Cove square flax packing—Dunham, Carrigan & Hayden Co.		25 00
1 brass bell—L. Foard		15 00
5,000 blank cards—Blake, Moffitt & Towne		6 30
5,000 envelopes, No. 6—Blake, Moffitt & Towne		7 60
60 doz. 8x10 Crown plates, 40 doz. 3¼x4¼ Crown plates—G. Cramer Dry Plate Works		137 70
Journal of Astrophysics—University of Chicago		4 00
Rock salt—Farmers' Union		25
1 gal. distilled water—Farmers' Union		30
1 qt. ammonia—Farmers' Union		25
Sapolio—Farmers' Union		25
Toilet paper—Farmers' Union		1 00
1 box candles—Farmers' Union		2 30
1 gal. distilled water—Farmers' Union		30
2 No. 14 oilers—Farmers' Union		80
2 No. 16 oilers—Farmers' Union		1 30
5 lbs. litharge—Farmers' Union		45
Marigold seed—Farmers' Union		25
California poppy seed—Farmers' Union		25
Hauling freight—J. Wandell		5 52
Hauling freight—J. Wandell		1 30
Freight—Southern Pacific Co.		10 56
Freight—Southern Pacific Co.		55
50 ft. oak molding, ½″—D. Rinaldo		2 00
20 ft. oak molding, 1″—D. Rinaldo		1 00
2 hanks sash cord—Cherrie & Co.		1 40
1 doz. hack-saw blades—Cherrie & Co.		85
2 mucilage bottles—E. H. Guppy & Son		1 00
24 lbs. B. G. seed—Farmers' Union		3 00
6 Rochester chimneys—Farmers' Union		60
10 doz. lantern slide cover-glasses—Farmers' Union		4 00
6 doz. lantern slide cover-glasses—Hirsch & Kahn		2 00
2 doz. drawer pulls—Mangrum & Otter		1 00
1 keg 4d nails—Mangrum & Otter		4 00
1 keg double-pointed tacks—Mangrum & Otter		25
6 10″ mill files—Mangrum & Otter		1 50
1 contact breaker—A. F. Poole		10 00
3 burners—Farmers' Union		45
Freight—Southern Pacific Co.		5 40
Telephone message—Sunset Tel. & Tel. Co.		30
Telegram—Western Union Tel. Co.		1 14
Hauling freight—J. Wandell		7 01
Hauling freight—J. Wandell		7 30
1 lantern—Farmers' Union		40
6 tin pie plates—Farmers' Union		25
2 electros—Charles Scribner's Sons		1 80
20 sheets tag board—Bonestell & Co.		2 00
20 sheets straw board—Bonestell & Co.		2 00
Cartage—Bonestell & Co.		25
1 quire paper—H. S. Crocker Co.		4 00
1 gal. benzine and case—Farmers' Union		40
Hauling freight—J. Wandell		3 95
1 bottom tap—Dunham, Carrigan & Hayden Co.		2 60
Work at Crossley dome—Henry Soto		1 00
$\frac{6}{10}$ cord of wood—J. Wandell		2 70
$3\frac{8}{10}$ cords wood—J. Wandell		17 10
Freight—Southern Pacific Co.		25
Hauling freight—L. Bernal		14 00
Hauling freight—J. Wandell		5 04
22 lbs. 1¼″ nuts—Farmers' Union		1 32
1 car bit, $\frac{9}{16}$″—Cherrie & Co.		75
1 car bit, $\frac{11}{16}$″—Cherrie & Co.		85

Department of Lick Observatory—Continued.

1 car bit, $\frac{13}{16}$″—Cherrie & Co.			$1 00
23 lbs. ½″ round iron—Farmers' Union			61
36 lbs. ⅝″ round iron—Farmers' Union			90
73 lbs. ¾″ round iron—Farmers' Union			1 64
119 lbs. 1½″ rope—Farmers' Union			11 90
¾ lb. ½″ washers—Farmers' Union			06
1¾ lbs. ⅝″ washers—Farmers' Union			10
2⅜ lbs. ¾″ washers—Farmers' Union			16
2¾ lbs. T nuts, ½″—Farmers' Union			17
14½ lbs. nuts, ⅝″ and ¾″—Farmers' Union			72
542 lbs. blacksmith coal—Farmers' Union			4 88
300 lbs. old lead—Mangrum & Otter			14 25
Hauling freight—L. Bernal			6 90
4 doz. boxes, 4½x3½—A. Fleishhacker & Co.			3 00
6 doz. boxes, 10x8x1¼—A. Fleishhacker & Co.			7 50
7 doz. boxes, 8½x6½x1¼—A. Fleishhacker & Co.			7 00
72 boxes, 5x4x1¼—A. Fleishhacker & Co.			3 96
1,000 ft. lumber—Glenwood Lumber Co.			27 00
500 ft. lumber—Glenwood Lumber Co.			13 50
1 base plate—O'Connell & Lewis			150 00
Making 12 stud bolts—David Wight			2 00
Iron and 12 nuts—David Wight			1 00
Cutting threads and topping nuts—David Wight			4 00
Himmel und Erde, VIII—Mayer & Müller			3 88
Postage on Comptes Rendus—Gauthier, Villars & Co.			2 76
3 doz. 5x7 Seed's plates, No. 27—Hirsch & Kahn			2 97
15 lbs. insulated wire—John A. Roebling's Sons Co.			2 97
1 copy Creele's Reduction Tables, half morocco—E. S. Holden			3 50
Bill of Farmers' Union:			
1 L.H. pipe die, ½″		$1 50	
1 L.H. pipe tap, ½″		1 00	
24 machine bolts, ¾x3½		2 14	
24 machine bolts, ⅝x3		1 46	
24 machine bolts, ⅝x2		1 32	
24 machine bolts, ⅝x2½		1 39	
24 machine bolts, ½x1½		86	
24 machine bolts, ½x1¾		92	
12 machine bolts, ⅝x½		62	
60 machine bolts, ½x2¼		2 40	
		$13 61	
Less		2 77	
			10 84
24 ¾x2¾ C. bolts—Farmer's Union			3 84
24 ⅝x2¾ C. bolts—Farmers' Union			2 40
Hauling freight—L. Bernal			1 62
Hauling lumber—L. Bernal			21 30
24 sheets No. 1 sandpaper	Dunham, Carrigan & Hayden Co.		9 67
24 sheets No. 1½ sandpaper			
24 sheets No. 2 sandpaper			
6 locks B., No. 3800			
$\frac{1}{6}$ doz. No. 5210 locks, B			
1 gross screws, No. 1114			
1 gross screws, No. 1111			
2 doz. No. 40 hooks and eyes, 1½″			
2 doz. No. 41 hooks and eyes, 2″			
25 lbs. 6d finishing wire nails			
12 cupboard catches, No. 3210			
6 ½ pts. com. Hepger glue			
1 doz. drawer pulls, 406			
½ doz. 6″ saw files			
6 5″ saw files			
600 No. 43 upholster nails			
1 gross flat head iron screws, 1½x10			
3 com. ax handles			
1 gross 1½x11 flat head iron screws			
6 10″ mill files			
1½ doz, ½″ belt couplings—Dunham, Carrigan & Hayden Co.			4 00
Bill of G. H. Tay Co.:			
150 ft. 2″ dipped pipe, at 11½c.		$17 25	
200 ft. 1½″ dipped pipe, at 8¾c.		17 50	
2 doz. 1″ elbows, at $2\frac{6}{10}$c.		62	
2 doz. 1″ nipples, at 2¾c.		66	
1 doz. 1½″ tees, at $6\frac{6}{10}$c.		79	
6 1½″ unions, at 18c.		1 08	

Department of Lick Observatory—Continued

Bill of G. H. Tay Co.—Continued.		
18 1½″ elbows, at 5½c.	$0 99	
2 doz. 1½″ nipples, at 5c.	1 20	
1 doz. 2″ elbows, at 7½c.	90	
1 doz. 2″ nipples, at 6½c.	78	
6 2½″ tees, at 17c.	1 02	
6 2½″ unions, at 45c.	2 70	
1 doz. 2½″ elbows, at 13c.	1 56	
1 doz. 2½″ nipples, at 14c.	1 68	
6 1½″ gate valves, at $1 57	9 42	
3 2½ ″ gate valves, at $4 80	14 40	
		$72 55
Expressage—Wells, Fargo & Co.		2 35
Hauling freight—F. P. Childs		1 98
1 light glass, 24x37—J. P. Jarman		1 10
Telegrams—Western Union Tel. Co.		6 07
Expressage—Wells, Fargo & Co.		2 15
Hauling freight—F. H. Ross & Sons		3 27
Freight—Southern Pacific Co.		25
2 doz. Carmel soap—Goldberg, Bowen & Lebenbaum		2 50
5 gals. black paint—J. P. Jarman		4 50
1 doz. solio paper, 11x14—Taber Photo Co.		1 50
1 doz. solio paper, 14x17—Taber Photo Co.		2 25
Hauling freight—J. Wandell		3 18
3 sash brushes—Farmers' Union		50
1 lot rubber bands—E. H. Guppy & Son		1 00
Freight—Southern Pacific Co.		26
Retouching portrait of Chauvenet—Taber Photo Co.		1 00
1 light glass 13¾x19¼—J. P. Jarman		40
1,532 ft. Oregon pine—Glenwood Lumber Co.		22 98
Bill of Hirsch & Kahn:		
5 doz. Carbutt A plates, 6¼x8½	$8 25	
5 doz. Seed's transparency plates	8 25	
	$16 50	
Less 10%	1 65	
		14 85
6-qt. sprinkling pot—Farmers' Union		45
Hauling freight—J. Wandell		1 03
1 Scientific American, 1895—Lemcke & Buechner		20
1 Astronomical Journal, Nos. 340, 358—Lemcke & Buechner		40
Freight—Southern Pacific Co.		25
Telegrams—Western Union Tel. Co.		2 53
Hauling freight—J. Wandell		1 34
1 slide board, 8½x12—S. C. Partridge		50
Postage—S. C. Partridge		20
Freight—Southern Pacific Co.		25
12 lbs. rivets—Farmers' Union		90
Expressage—Farmers' Union		25
2 No. 73 hammers—Farmers' Union		1 40
20 lbs. rivets—Farmers' Union		1 50
48 lbs. rivets—Farmers' Union		1 44
400 rivets, ⅜x¼—Union Iron Works		60
1 half-tone—Bolton & Strong		6 45
3½ days labor—Eugene Gray		6 12
12 days labor—Eugene Gray		21 00
12 days labor—Edw. James		21 00
Labor—Otto Pauli		15 00
Labor—E. Gray		9 62
Labor—E. James		9 62
100 lbs. iron—Mangrum & Otter		7 00
Labor, man and helper—Mangrum & Otter		2 25
4 doz 8x10 Karsak paper, and postage—Hirsch & Kahn		2 87
1 can axle grease—Farmers' Union		10
1 blacksnake whip—Farmers' Union		80
Shoemaker's wax—Farmers' Union		25
1 pt. acetic acid—Hirsch & Kahn		25
1 pt. hydrochinon acid—Hirsch & Kahn		50
Freight—Southern Pacific Co.		1 04
29 lbs. zinc—Mangrum & Otter		2 90
Hauling freight—L. Bernal		5 68
Labor—O. Pauli		9 00
Labor—Edward James		4 37
Labor—O. Pauli		12 00

Department of Lick Observatory—Continued.

Labor—Edward James		$7 87
Labor—Eugene Gray		7 87
Sand—J. R. Kincaid		6 64
400 lbs. ¼x¾ round head rivets—Farmers' Union		30 00
20 lbs. 1½x½ round head rivets—Farmers' Union		1 50
16 lbs. 2x½ round head rivets—Farmers' Union		1 20
1 No. 7 euryscope lense—Hirsch & Kahn		71 00
12 Mann's copy-books, 10x14—Payot, Upham & Co.		10 80
1 L'Astronomie, Vol. 8—Lemcke & Buechner		3 30
2 bracket lamps, No. 11—Nathan, Dohrmann & Co.		9 70
Bill of Hirsch & Kahn:		
6 doz. 14x17 Carbutt's A plates	$54 00	
4 doz. 14x17 Carbutt's B plates	36 00	
	$90 00	
Less 10%	9 00	
		81 00
320 lbs. double refined bluestone—Paul Seiler Electrical Works		6 80
12 6x8 jars—Paul Seiler Electrical Works		4 80
12 6x8 zincs—Paul Seiler Electrical Works		4 20
12 coppers—Paul Seiler Electrical Works		1 50
24 rubber bands—Paul Seiler Electrical Works		50
8 portraits of famous astronomers—Macmillan & Co.		12 00
50 yds. Napier matting—Rucker Bros.		30 00
100 yds. Napier matting—Rucker Bros.		60 00
74 yds. denim—C. M. Plum & Co.		14 80
Printing 200 copies of a cipher code—Astronomical Society of the Pacific		20 00
Bill of Hirsch & Kahn:		
1 11x14 deep printing frame	$2 16	
1 14x17 deep printing frame	2 70	
2 14x17 hard rubber trays	7 65	
1 gal. alcohol	2 70	
4 doz. 6½x8½ solio paper	1 98	
4 doz. 8x10 solio paper	2 70	
2 doz. 11x14 solio paper	2 25	
2 doz. 14x17 solio paper	3 33	
		25 47
2 8x10 Daisy plate-holders—Hirsch & Kahn		10 80
2 6½x8½ vulcanized rubber trays—Hirsch & Kahn		1 35
2 lbs. carbonate of soda—Hirsch & Kahn		27
1 lb. eikonogen—Hirsch & Kahn		3 55
2 18x22 H. R. trays—Hirsch & Kahn		10 35
2 Rochester metal lamps—T. P. Andrews		5 00
1 8x10 hard rubber tray—T. P. Andrews		92
1 oz. bromide of potash—T. P. Andrews		10
2 lbs. hydrochinon—T. P. Andrews		7 00
Bill of Yates & Co.:		
200 lbs. best white lead	$12 00	
10 gals. raw linseed oil	5 30	
5 gals. turpentine	2 35	
6 1-lb. cans burnt umber	60	
3 No. 25 Adams brushes	2 40	
3 No. 30 Adams brushes	3 15	
	$25 80	
Less 2%	50	
		25 30
Bill of J. Caire Co.:		
5 lbs. powdered alum	$0 50	
5 lbs. caustic potash	2 75	
10 lbs. sulphite of soda	2 00	
2 kegs hypo. soda	6 27	
1 glass mortar and pestle, 4″	30	
1 glass graduate, 16-oz.	55	
1 glass graduate, 8-oz.	30	
2 glass graduates, 4-oz.	40	
2 glass graduates, 1-oz.	30	
1 keg hyposulphite of soda, 112 lbs.	3 13	
15 lbs. sulphite of soda crystals, in 1-lb. bottles	3 00	
5 lbs. potassium carbonate, in 1-lb. bottles	1 00	
½ lb. hydrochinon	1 75	
1 15-gr. bottle chloride of gold	50	
1 lb. (bottle) sulphuric acid	25	
		23 00

Department of Lick Observatory—Continued.

Bill of Pacific Pine Lumber Co.:		
200 ft. ½ x12 sugar pine, S. 2 S.	$11 11	
100 ft. ½″ ash, S. 2 S.	7 28	
100 ft. ¾″ ash, S. 2 S.	10 71	
100 ft. 1¼″ ash, S. 2 S.	10 82	
100 ft. 2″ ash, S. 2 S.	10 82	
100 ft. ¼″ Spanish cedar S. 2 S.	6 91	
100 ft. ½″ Spanish cedar, S. 2 S.	10 00	
100 ft. ¾″ Spanish cedar, S. 2 S.	15 05	
100 ft. 1″ Spanish cedar, S. 2 S.	15 14	
1 piece 3x18x18 Oregon pine, S. 2 S.	2 20	
500 ft. 1 x4 Oregon pine flooring	12 03	
		$112 07
12 books, at 34c.—E. S. Holden		4 08
16 folio pamphlets, at 20c.—E. S. Holden		3 20
34 quarto pamphlets, at 20c.—E. S. Holden		6 80
72 octavo pamphlets, at 15c.—E. S. Holden		10 80
8 lbs. rivets—Farmers' Union		60
Expressage—Wells, Fargo & Co.		25
1 mirror—Rucker Bros.		2 50
50 tubes, 15 x 2—A. Fleishhacker & Co.		2 00
5 lbs. drop black—W. P. Fuller & Co.		90
6 Rochester chimneys—Farmers' Union		60
5 gals. turpentine—Farmers' Union		2 75
3 doz. hooks—Farmers' Union		75
2 boxes picture wire—Farmers' Union		25
Hauling freight—F. H. Ross & Sons		3 23
Expressage—F. H. Ross & Sons		7 65
10 lbs. litharge—Farmers' Union		90
3 lbs. burnt umber—Farmers' Union		60
Postage stamps—A. L. Colton, P. M.		75
1 lb. beeswax—Farmers' Union		40
Freight—Southern Pacific Co.		36
4 gals. black asphaltum—Farmers' Union		3 40
2 bullseye lanterns—San José Hardware Co.		1 20
1 piece wire screen—San José Hardware Co.		15
2 Columbian ink stands—H. S. Crocker & Co.		1 50
1 art square—L. Lion & Sons Co.		4 00
Freight—Southern Pacific Co.		35
1 pr. bridles—F. M. Stern		4 00
3 awls—F. M. Stern		75
2 doz. hack-saw blades, 10″—Cherrie & Co.		1 50
1 adjustable hack-saw frame—Cherrie & Co.		1 00
Hauling—J. Wandell		3 28
1 burnisher polished—Will & Finck Co.		50
8 lbs. 1x⅜ round head rivets—Farmers' Union		60
18 lbs. 1⅛x⅜ round head rivets—Farmers' Union		1 35
7 lbs. 1⅜x⅜ round head rivets—Farmers' Union		53
10 lbs. lamp black, dry—Farmers' Union		1 50
3 gals. alcohol—Brassy & Co.		9 00
1 demijohn—Brassy & Co.		75
1 lamp—Farmers' Union		2 25
7 days labor—Edward James		12 25
7 days labor—Eugene Gray		12 25
7 days labor—Otto Pauli		14 00
1 doz. ink, carmine—Payot, Upham & Co.		75
1 doz. ink, Higgin's—Payot, Upham & Co.		2 40
2 boxes McGill's F. H. fasteners, No. 2—Payot, Upham & Co.		20
2 boxes McGill's F. H. fasteners, No. 3—Payot, Upham & Co.		20
2 qts. Carter's mucilage—Payot, Upham & Co		90
12 pts. Carter's violet—Payot, Upham & Co.		2 40
4 doz. 8x10 Seed's plates, No. 27—Hirsch & Kahn		10 00
4 doz. 6½x8½ Seed's plates, No. 27—Hirsch & Kahn		5 00
4 doz. 5x7 Seed's plates, No. 27—Hirsch & Kahn		5 00
5 doz. 6½x8½ Carbutt's A plates—Hirsch & Kahn		8 00
4 doz. Carbutt's lantern slide plates—Hirsch & Kahn		2 00
Oxford University Calendar, 1896—James Parker & Co.		1 60
1 No. 1 Orient oil-stove—John Stock Sons		5 50
5 cases coaloil—Farmers' Union		10 00
1 Ball's Atlas of Astronomy—Lemcke & Buechner		4 00
1 sash, 2x10—Glenwood Lumber Co.		2 00
6 yds. creton—Hart & Roberts		75
Hauling lumber—L. Bernal		15 00
24 yds. toweling—Farmers' Union		2 40

Department of Lick Observatory—Continued.

1 piece leather—F. M. Stern		$0 85
Hauling freight—J. Wandell		1 36
1 qt. mucilage—E. H. Guppy & Son		1 00
4 shades—L. Lion & Sons Co.		3 40
Freight—Southern Pacific Co.		25
Repairs on tool-post—David Wight		1 50
50 ft. ½″ and 50 ft. 1″ molding—D. Rinaldo		4 50
1 doz. Fenotype plates—Hirsch & Kahn		1 08
Soap—Farmers' Union		50
1 10-v. lamp—Paul Seiler Electrical Works		95
2 doz. wicks—Farmers' Union		20
Assorted rubber bands—Payot, Upham & Co.		1 20
Hauling freight—J. Wandell		1 88
2 bars ½″ iron—Farmers' Union		50
2 bars ⅝″ iron—Farmers' Union		60
1 bar ¾″ iron—Farmers' Union		45
1 bar 1″ iron—Farmers' Union		70
3 pr. chest handles—Farmers' Union		75
3¾ lbs. sash cord—Farmers' Union		1 13
1 doz. boxes, 17¼x14¼x1⅛—A. Fleishhacker & Co.		1 50
Freight—Southern Pacific Co.		25
Repairing Daisy plate-holder—S. C. Partridge		2 00
1 gross pens—Payot, Upham & Co.		75
Postage—Payot, Upham & Co.		04
Expressage—Wells, Fargo & Co.		19 70
Hauling—F. H. Ross & Sons		6 06
Telegrams—Western Union Tel. Co.		8 59
1 keg cut nails, 6d, finishing—Cherrie & Co.		4 25
1 keg cut nails, 8d, common—Cherrie & Co.		3 75
1 keg common nails, wire, 6d—Cherrie & Co.		4 10
Subscription for one year—Science		5 00
1 8-oz. glass funnel—John Taylor & Co.		14
2 4-oz. glass funnels—John Taylor & Co.		20
2 lbs. caustic potash—John Taylor & Co.		80
2 lbs. caustic soda—John Taylor & Co.		80
5 lbs. powdered alum—John Taylor & Co.		25
5 cords four-foot wood—J. Wandell		22 50
Bill of Hicks-Judd Co. for binding:		
1 folio, half mor.	$1 80	
1 4to, half mor.	1 35	
1 8vo, half mor.	90	
4 8vos, half w. g.	3 40	
5 4tos, half w. g.	5 50	
1 small folio, w. g.	1 35	
11 8vos, half roan	7 15	
12 4tos, half roan	10 80	
1 small folio, half roan	1 15	
1 medium folio, half roan	1 55	
4 books repaired and lettered	2 20	
	$37 15	
Less	25	36 90
3 10″ half-round files—Ingalls & Stock		44
3 12″ flat files—Ingalls & Stock		56
2 sacks charcoal—Cherrie & Co.		80
6 bars solder—Cherrie & Co.		1 80
2 doz. hack-saw blades—Cherrie & Co.		1 50
6 mill saw files, 12″—Cherrie & Co.		65
2 round files, 12″—Cherrie & Co.		30
2 round files, 10″—Cherrie & Co.		25
2 round files, 6″—Cherrie & Co.		15
3 cords four-foot wood—J. Wandell		13 50
		$5,422 66

APPENDIX NO. 13—*Department of Military Science.*

Expressage—Geo. Dalton	$2 00
6 tins Brilliantshine—Goldberg, Bowen & Lebenbaum	1 15
2 doz. Acme polish—Goldberg, Bowen & Lebenbaum	4 30
1 doz. harness dressing—Goldberg, Bowen & Lebenbaum	3 00
12 sheets emery cloth—Goldberg, Bowen & Lebenbaum	70
6 tripoli—Goldberg, Bowen & Lebenbaum	10
6 yds. Canton flannel—Goldberg, Bowen & Lebenbaum	75
1 qt. alcohol—Goldberg, Bowen & Lebenbaum	65
1 bot. vaseline, Goldberg, Bowen & Lebenbaum	65

Department of Military Science—Continued.

Freight—Southern Pacific Co.		$32 50
Freight—Southern Pacific Co.		1 62
Expressage—Southern Pacific Co.		1 75
2 electrotypes—The Century Co.		5 00
1 st. and pad—P. P. Bernhardt & Co.		1 00
1 20-ft. post flag, Ames & Harris		15 00
1 32″ bass drum—Kohler & Chase		11 00
Repairs on marine glass—Chas. Hess		6 00
Vaseline—Goldberg, Bowen & Lebenbaum		50
1 qt. alcohol—Goldberg, Bowen & Lebenbaum		65
1 doz. Mason's shoe blacking—Goldberg, Bowen & Lebenbaum		60
6 shoe brushes—Goldberg, Bowen & Lebenbaum		1 40
6 small whisk brooms—Goldberg, Bowen & Lebenbaum		1 05
1 bottle Acme blacking—Goldberg, Bowen & Lebenbaum		20
Expressage—Patterson & Co.		3 25
5 cans Brilliantshine—Goldberg, Bowen & Lebenbaum		1 15
2 1-lb. cans vaseline—Goldberg, Bowen & Lebenbaum		1 00
10 yds. flannel—Goldberg, Bowen & Lebenbaum		1 00
6 bottles Acme polish—Goldberg, Bowen & Lebenbaum		1 15
Bill of Kohler & Chase:		
1 Soldier's Life	$2 00	
1 Vision of Paradise	2 00	
1 Murmuring Breeze	1 00	
1 Old Glory	50	
1 Wayside Chapel	50	
1 Summer Night	50	
1 Always Happy	50	
1 Sons of America	50	
1 Honeymoon March	50	
1 Sidewalks of New York March	50	
1 Big 4	50	
1 bf. brass nope	1 00	
1 knee rest	50	
1 doz. Meyer reeds	1 50	
	$12 00	
Less 20%	2 40	9 60
1 bugle—Sherman, Clay & Co.		4 25
Clerical work—P. L. Bush		10 00
Military ornaments cleaned—F. Thomas Dyeing Works		4 50
Expressage—F. Thomas Dyeing Works		40
Repairing 1 silk banner and 2 flags—E. J. C. Gilbert		90
Traveling expenses—J. E. Sellman		1 80
1 second-hand typewriter—G. G. Wickson & Co.		55 00
2 medals—Shreve & Co.		25 00
2 McClellan saddles—J. C. Johnson & Co.		42 00
2 bridles, with Shoemaker bits—J. C. Johnson & Co.		10 00
2 saddle blankets—J. C. Johnson & Co.		2 50
2 saddle cloths, with binding—J. C. Johnson & Co.		9 50
Use of saddle horse—H. M. Waterbury		4 00
10 band plates and belts—J. M. Litchfield & Co.		6 50
Use of horse—F. Esmond		1 00
Use of target—Capt. L. Siebe		13 50
Expressage—Patterson & Co.		3 00
Expressage—Patterson & Co.		2 50
Clerical work—P. L. Bush		5 00
6 blank books—Students' Coöp. Ass'n		60
$\frac{5}{12}$ doz. memorandum books—Students' Coöp. Ass'n		1 40
250 envelopes—Students' Coöp. Ass'n		1 00
1 doz. memorandum books—Students' Coöp. Ass'n		3 35
"Elements of Military Science"—Students' Coöp. Ass'n		1 00
1 large binder—Students' Coöp. Ass'n		20
1 small binder—Students' Coöp. Ass'n		15
1 qt. bottle copying ink—Students' Coöp. Ass'n		45
1 3-oz. bottle Stafford's writing fluid—Students' Coöp. Ass'n		15
2 theme pads—Students' Coöp. Ass'n		40
50 2-cent stamps—Students' Coöp. Ass'n		1 00
2-cent postage stamps—Students' Coöp. Ass'n		2 00
1 Eb clar. buffet—Kohler & Chase		26 00
1 Bb clar. buffet—Kohler & Chase		26 00
1 Eb tuba higham—Kohler & Chase		75 00
1 Bb baritone—Kohler & Chase		60 00
Expressage—Patterson & Co		75
Clerical work—P. L. Bush		5 00

Department of Military Science—Continued.

1	Carter's H. S. & B.—U. S. Cavalry and Infantry School	$2 65
1	Root's M. T. & S.—U. S. Cavalry and Infantry School	1 50
1	Doty's Aid—D. Appleton & Co.	1 13
	Postage—D. Appleton & Co.	09
1	Mercur. Attack.—John Wiley & Sons	1 60
	Postage—John Wiley & Sons	10
6	lead pencils—Students' Coöp. Ass'n	15
1	blue and red pencil—Students' Coöp. Ass'n	20
2	erasers—Students' Coöp. Ass'n	10
6	note books—Students' Coöp. Ass'n	60
	Red ink, and pens—Students' Coöp. Ass'n	30
2	theme pads—Students' Coöp. Ass'n	50
5	sheets carbon paper—Students' Coöp. Ass'n	25
500	sheets typewriter paper—Students' Coöp. Ass'n	1 00
1	ink eraser—Students' Coöp. Ass'n	05
5	indelible pencils—Student's Coöp. Ass'n	50
8	pieces music—Kohler & Chase	3 34
7	ft. drawing paper—Sanborn, Vail & Co.	3 15
1	book and 1,000 blanks—J. B. McIntyre	10 00
	Binding 2,000 pamphlets—J. B. McIntyre	6 00
	Expressage—Patterson & Co.	2 50
	Journal of U. S. Artillery, 1896—Journal of U. S. Artillery	2 50
	Clausewitz on War 1873—Richardson & Co.	2 13
12	sears—U. S. Ordnance Department	2 04
24	bayonet clasp screws—U. S. Ordnance Department	24
4	bayonet clasps—U. S. Ordnance Department	52
100	brass rivets—U. S. Ordnance Department	10
25	firing pins—U. S. Ordnance Department	2 50
4	side screws—U. S. Ordnance Department	12
4	tank screws—U. S. Ordnance Department	08
2	saber belts—U. S. Ordnance Department	2 10
	Use of target—L. Siebe	10 75
10	stocks—The United States	11 50
2	bayonet clasp screws—The United States	02
1	packing box—The United States	1 00
	Binding 9 vols. "Regulations"—J. B. McIntyre	4 50
5	lbs. oil—H. W. Baxter	1 00
	Folding and stitching 600 pamphlets—Hicks-Judd Co.	1 25
9½	lbs. rope—Geo. Webb Alexander	1 45
	Expressage—Patterson & Co.	75
	Rent of target—Capt. L. Siebe	4 75
	Journal of Royal United Service Institution, January to June, 1896, and postage—B. F. Stevens	3 29
	Clerical work—Phillip L. Bush	5 00
	Reloading 2,000 blank cartridges—C. W. Burgans	10 00
	Binding 12 books—Hicks-Judd Co.	1 50
	Use of target and marker—L. Siebe	1 00
	Freight—Southern Pacific Co.	2 50
	Expressage—Patterson & Co.	2 25
	Expressage—Patterson & Co.	1 00
	Freight—Southern Pacific Co.	3 07
		$628 54

APPENDIX No. 14—*Department of Mineralogy.*

	Expressage—Wells, Fargo & Co.	$1 25
	Freight—Southern Pacific Co.	36
	Expressage—Patterson & Co.	1 25
	Expressage—Patterson & Co.	1 00
1	line engraving, 8x5½—Bolton & Strong	4 20
2	line engravings, small—Bolton & Strong	2 00
750	copies each, Nos. 10 and 11, Geology Bulletin, Vol. 1—Pacific Press Pub. Co.	73 00
	Freight—Southern Pacific Co.	2 55
	Expressage—Patterson & Co.	1 00
9	keys fitted—A. Erlandsen	2 05
28	sheets M. B. cream—Blake, Moffitt & Towne	1 12
1	ream Jap. woven folio—Blake, Moffitt & Towne	6 05
3,000	No. 6 envelopes—Blake, Moffitt & Towne	5 04
	Freight—Southern Pacific Co.	1 07
	Expressage—Patterson & Co.	50
	Expressage—Wells, Fargo & Co.	1 00
3⅓	karats diamond bort—Victor Bishop & Co.	5 00
	Freight—Southern Pacific Co.	88
	Expressage—Patterson & Co.	25
	Expressage—Patterson & Co.	75

Department of Mineralogy—Continued.

Bill of J. Caire Co.:		
400 pieces plate glass, 1½″x1½″x¼″	$3 00	
1 oz. platinum bichloride solution, C. P.	1 20	
2 lbs. HNO_3, C. P.	50	
3 lbs. H_2SO_4, C. P.	75	
½ lb. ammonium carbonate, C. P.	25	
½ lb. potassium carbonate, C. P.	25	
6 tips for Bunsen burners	1 20	
2 pkgs. 5½-cm. filter paper	24	
3 pkgs. 11-cm. filter paper	60	
1 pkg. 15-cm. filter paper	27	
1 doz. test tubes, 5″x½″	20	
2 7″ shallow watch glasses	78	
		$9 24
1 half-tone, 4x3—Bolton & Strong		3 00
5 small line engravings—Bolton & Strong		5 00
1 line engraving—Bolton & Strong		1 20
Clerical work—W. O. Smith		9 40
108 crystal models—Eimer & Amend		20 00
2 iron starting-boxes—W. H. Lozier		7 00
Expressage—Patterson & Co.		75
Bill of John Taylor & Co:		
6 lbs. HCl, C. P.	$1 15	
¼ lb. hydrofluoric acid, Merck's, C. P.	75	
½ lb. bisulphate of potassium, C. P.	55	
¼ lb. potassium hydrate, C. P.	25	
¼ lb. permanganate of potassium, C. P.	12	
1 oz. ammonium molybdate, C. P.	25	
6 Bunsen burners	1 80	
2 6″ porcelain evaporating dishes, deep form	60	
3 lbs. sodium wolframate, C. P.	2 40	
5 lbs. boracic acid, pure (crystals)	1 25	
1 lb. barium chloride, C. P.	30	
1½ lbs. cadmium sulphate	3 75	
		13 17
750 copies Bulletin Dept. of Geology, Vol. 1, No. 12—Pacific Press Pub. Co.		72 25
105 lantern slides—Edwin E. Howell		47 25
Expressage—Wells, Fargo & Co.		9 10
Expressage—Patterson & Co.		46
1 mineralogical specimen—H. W. Fairbanks		3 00
Bill of George Breck:		
1 Criterion lantern	$60 00	
1 automatic electric lamp, 110-volt.	60 00	
	$120 00	
Less 10%	12 00	
		108 00
3 half-tone plates—Bolton & Strong		7 50
4 line cuts—Bolton & Strong		4 00
1 line cut, 41 sq. in.—Bolton & Strong		4 10
1 line cut, 42 sq. in.—Bolton & Strong		4 20
200 ft. No. 12 covered wire—R. W. Lohmann & Co.		6 00
15-amp. switch, fuse block, insulators, etc.—R. W. Lohmann & Co.		1 50
Time, per contract—R. W. Lohmann & Co.		5 00
Printing 750 copies Bulletin Dept. of Geology—Pacific Press Pub. Co.		234 25
Postage stamps—John McCarthy, P. M.		5 00
Expressage—Patterson & Co.		2 25
		$692 94

APPENDIX No. 15—*Department of Physical Culture.*

White's Physiological Manikin—J. M. Williamson	$25 00
Expressage—Patterson & Co.	25
2 6-ft. steel tapes—J. Caire Co.	3 00
1 Smyrna rug—C. W. Kinsey	3 00
Clerical work—M. S. Blanchard	7 30
Clerical work—A. E. Pierce	7 20
Clerical work—Geo. E. Ebright	4 00
Clerical work—E. J. Sherman	4 00

Department of Physical Culture—Continued.

Bill of Narragansett Machine Co.:		
40 barbells, 5 lbs. each	$36 00	
3⅓ doz. barbell racks, mounted	5 00	
25 prs. 1-lb. Indian clubs	10 00	
25 prs. club-hooks, mounted	6 25	
50 prs. 2-lb. wooden dumbbells	25 00	
50 prs. bell-hooks, mounted	15 00	
1 No. 300 ankle machine	25 00	
	$122 25	
Less 25%	30 56	
	$91 69	
Freight charges	13 70	
		$105 39
1 ream 28-lb. Ashland folio—Blake, Moffitt & Towne		3 64
1,000 No. 6 envelopes—Blake, Moffitt & Towne		1 68
Clerical work—Miss D. Whitehead		1 20
Clerical work—Edna Robinson		4 60
Clerical work—Estelle J. Barden		1 40
Clerical work—E. B. McLellan		4 00
Clerical work—Helen M. Grace		1 80
Freight—Southern Pacific Co.		4 70
Expressage—Patterson & Co.		2 50
Bill of George Tiemann & Co.		
1 Anderson's calipers	$5 50	
1 Camman's stethoscope	4 50	
1 Flint's hammer	75	
1 Flint's pleximeter	35	
	$11 10	
Less 25%	2 77	
	$8 33	
1 Mosher's pelvic oblique metre	35 00	
		43 33
1 sash—Johnson & Cavan		10 00
Freight—Southern Pacific Co.		2 40
Expressage—Patterson & Co.		25
Repairing 10 mattresses—J. B. Wilson		6 00
1 No. 7 rip saw—Schmitt & Zehner		2 00
1 level—Schmitt & Zehner		1 00
1 can Le Page's glue—Schmitt & Zehner		25
1 doz. snaps—Schmitt & Zehner		45
1 qt. Eureka oil—Schmitt & Zehner		20
1 paint brush—Schmitt & Zehner		35
1 pr. gas pliers—A. Erlandsen		75
1 set stencils—A. Erlandsen		1 25
1 doz. sapolio—A. Erlandsen		1 00
6 agate cups—A. Erlandsen		1 00
1 indexed record book—Le Count Bros.		1 50
16 prs. union roller door hangers—C. L. Maxwell & Sons		16 00
80 ft. wrought track and screws—C. L. Maxwell & Sons		5 60
14x4½ art square—Metropolitan Furniture Co.		15 00
Clerical work—R. H. Hutchinson		15 80
Clerical work—Frederick Boegle		13 80
Parke's Hygiene—P. Blakiston, Son & Co.		2 25
Higgins Opthal. Practice—P. Blakiston, Son & Co.		1 35
Van Harlingen on Skin—P. Blakiston, Son & Co.		2 48
Day on Headache—P. Blakiston, Son & Co.		90
Expressage—P. Blakiston, Son & Co.		50
"What our Girls Ought to Know."—Funk & Wagnalls Co.		76
1 set test worsteds—Narragansett Machine Co.	$4 00	
1 Seaver rod—Narragansett Machine Co.	4 00	
1 sphygmograph—Narragansett Machine Co.	25 00	
	$33 00	
Less 20%	6 60	
		26 40
2 wand racks, mounted—Narragansett Machine Co.		1 50
Expressage—Wells, Fargo & Co.		4 50
5 lbs. rosin—H. D. Kelsey		25
2 doz. sapolio—Jos. McClain & Co.		1 80
10 gals. coaloil—Jos. McClain & Co.		2 00
1 doz. cans lye—Jos. McClain & Co.		80
½ gal. sperm oil—Jos. McClain & Co.		75

Department of Physical Culture—Continued.

	£.	s.	d.	
Bill of E. Hawksley, in pounds, shillings and pence, total in dollars and cents:				
1 Greenfield's cyrtometer	0	15	6	
1 double chest tape		5		
1 coxankylometer	2	2		
Box and packing		2	6	
	£3	5	0	$15 92
Changing 16 doors and making 8 grates—C. C. Underwood				16 00
Expressage—Patterson & Co.				25
Clerical work—B. H. Donnell				5 00
Clerical work—M. H. Peck				5 00
Ruling (and paper) 650 blanks, 11x17 28-lb. Whiting folio—Hicks-Judd Co.				4 05
Binders for same—Hicks-Judd Co.				1 00
Binding 2 medical examination books—Hicks-Judd Co.				2 00
Covering and polishing desk—J. B. Wilson				3 00
Fitting keys—J. B. Wilson				1 75
1 Naché Trial Case—A. Steffanoni				25 00
6 hours' clerical work—E. Boegle				1 20
1 striking-bag—Clabrough, Golcher & Co.				8 00
Customs charges—Davies, Turner & Co.				5 13
Expressage—Wells, Fargo & Co.				1 00
Expressage—Patterson & Co.				25
				$463 38

APPENDIX No. 16—*Department of Physics.*

	Marks.	
Expressage—Patterson & Co.		$0 25
Marine insurance—Balfour, Guthrie & Co.		40
1 strip sheet lead, ¼x1⅛x10 ft.—Pacific Tool and Supply Co.		1 50
1 bar solder, 2½ lbs.—Pacific Tool and Supply Co.		49
1 Stubs' saw blade, 8″—Pacific Tool and Supply Co.		30
1 box candles—Merriam & Co.		85
Bill of Jas. R. McDonald & Co., in marks; total in dollars and cents:		
1 telescope objective, No. 17	8.00	
4 telescope objectives, No. 19	56.00	
5 telescope oculars, No. 55	50.00	
5 cross lines for oculars, No. 80	15.00	
	Mks. 129.00	
Discount 10%	12.90	
	Mks. 116.10	
Discount 2%	2.32	
	Mks. 113.78	
1 spectroscope	95.00	
	Mks. 208.78	
Freight, packing, commission, etc.	37.55	
	Mks. 246.33	59 73
Freight—Southern Pacific Co.		5 66
Expressage—Patterson & Co.		75
3 oz. citr. iron and ammonia—Kirkland & Trowbridge		45
3 oz. red prussiate potash—Kirkland & Trowbridge		30
30 wood seat stools—Indianapolis Furniture Co.		18 75
20 tables—Niehaus Bros. & Co.		85 00
Expressage—Patterson & Co.		3 00
3 ft. 1½″ poplar—Allen & Higgins Lumber Co.		1 10
1 block plane—Schmitt & Zehner		90
2 Vernier calipers—John Taylor & Co.		2 00
150 ft. ⅝″ redwood, ¼ round—G. C. Pape		75
1 piece hard, black rubber, 5¼ lbs.—Pacific Tool and Supply Co.		6 56
3 ft. sawed brass, 3¼ lbs.—Pacific Tool and Supply Co.		98
2 ft. red rubber rod, ½ lb.—Pacific Tool and Supply Co.		63
½ ream No. 12 mimeograph paper—United Typewriter and Supplies Co.		14 00
2 1-lb. cans black ink—United Typewriter and Supplies Co.		2 80
2 small bots. mimeograph varnish—United Typewriter and Supplies Co.		40
4 sheets perforating silk—United Typewriter and Supplies Co.		1 44
10 yds. cheesecloth—Max Greenhood		50
1 gal. E. C. No. 2 paint—Paraffine Paint Co.		1 50

Department of Physics—Continued.

Bill of C. F. Marwedel:		
Round brass rod (hard):		
6 rods, ¼″, 10 ft. long; 3 rods, ½″, 10 ft. long; 1 rod, ⅝″, 10 ft. long; 1 rod, ¾″, 10 ft. long; 1 rod, 1½″, 3 ft. long	$10 48	
2 pieces sawed strip brass, ⅜″x ¾″, 6 ft. long; 1 piece sawed strip brass, ½″x ¾″, 6 ft. long	4 18	
1 whole piece sheet brass, No. 28, B. & S. gauge, 12″ wide	57	
1 oz. silver solder, thin sheet	1 25	
12 Eureka hack-saw blades, flexible back, 8″ between holes, about 14 teeth to the inch	55	
6 extra Star hack-saw blades, 20 teeth to the inch	30	
12 jeweler's hack-saw blades, 4″	15	
1 Armstrong tool-holder with 9 tools, in case No. A O	2 65	
1 each, Starrett's lock nut caliper, outside and inside, style 38-12, 39-10	2 38	
		$22 51
Bill of American Electric Works:		
German silver wire, double silk covered, B. & S. gauge: 4$\frac{14}{16}$ lbs. No. 16; 5$\frac{1}{16}$ lbs. No. 20; 4¼ lbs. No. 25; 5¼ lbs. No. 27	$40 89	
10 lbs. No. 18 magnet wire, copper, double, cotton covered, B. & S. gauge	2 50	
10 lbs. No. 20 magnet wire, copper, double, cotton covered, B. & S. gauge	2 96	
5 lbs. No. 32 magnet wire, copper, double, cotton covered, B. & S. gauge	5 70	
20 lbs. annunciator wire, No. 16	3 50	
10 lbs. annunciator wire, No. 19	1 95	
1¼ lbs. rubber tape	81	
150 ft. 14 silk lamp cord, 300 ft. 18 silk lamp cord	9 15	
5 lbs. No. 19 copper wire	80	
5 lbs. No. 22 copper wire	88	
5$\frac{1}{16}$ lbs. No. 25 copper wire	1 01	
		70 15
960 lbs. ice—G. N. Martin		9 60
2 tuning forks—Clark, Wise & Co.		45
Bill of Pacific Tool and Supply Co.:		
Square brass rod (hard):		
1 rod ¼″, 10 ft. long	$0 45	
2 rod $\frac{5}{16}$″, 10 ft. long	1 26	
2 rod ⅜″, 10 ft. long	1 85	
2 rod ½″, 10 ft. long	3 24	
1 rod ⅝″, 10 ft. long	2 52	
1 piece round copper rod, ⅝″ diam., 1 ft. long	23	
1 piece round copper rod, 1″ diam., 1 ft. long	54	
Brass telescope tubing, best seamless:		
5 ft. seamless tubing to fit over 1$\frac{5}{16}$ tubing	1 40	
3 ft. ¾″ seamless, $\frac{1}{20}$″ wall to telescope	54	
3 ft. 1$\frac{1}{16}$″ seamless, $\frac{1}{32}$″ wall to telescope	66	
3 ft. 1″ seamless, $\frac{1}{20}$″ wall to telescope	66	
Emery cloth, Barton's best, 1 quire of each: Nos. 00, 0, 1, 1½, 2	2 50	
2 pieces 5″ diam. thick walrus hide	2 00	
1 Buffalo Tool Co. Knurling set, in case	5 00	
1 Skinner milling machine chuck, universal, 4″ diam., style 304-D, and face-plate casting	15 00	
1 10″ Stillson pipe-wrench	1 15	
Stubs' drill gauge, 1 each, number, 61 to 70 inclusive	40	
1 $\frac{5}{16}$″ Stubs' drill gauge	18	
1 $\frac{13}{32}$″ Stubs' drill gauge	25	
Files, Grobet, Swiss:		
1 hand, one safe edge, 10″ No. 0	50	
1 pillar, two safe edges, 6″ No. 1	20	
2 pillar, two safe edges, 6″ No. 4	50	
1 half-width pillar, two safe edges, 8″ No. 2	35	
1 half-round, 8″ No. 4	35	
2 round, 4″ No. 2	30	
1 three-square, 5″ No. 2	25	
1 three-square, 5″ No. 5	25	
1 hand, one safe edge, 8″ No. 2	35	
American files:		
1 hand, one safe edge, bastard, 10″	20	
1 float, two square edges, 8″	15	
1 half-round, second cut, 8″	15	
Stubs' broaches, 1 each, large diameter: $\frac{1}{16}$″, ⅛″, $\frac{3}{16}$″, ¼″, $\frac{3}{32}$″	85	
5 lbs. hard copper wire, No. 16, B. & S. gauge	1 00	
5 lbs. hard German silver wire, No. 16, B. & S. gauge	3 00	

Department of Physics—Continued.

Bill of Pacific Tool and Supply Co.—Continued.		
2 lbs. hard German silver wire, No. 19, B. & S. gauge	$1 30	
3 ft. square aluminum rod, ¼"	50	
Machine screw taps, one each, ⅛"-40, $\frac{3}{16}$"-32, $\frac{5}{32}$"-36	60	
		$50 13
Bill of J. Caire Co.:		
¼ lb. tripoli	$ 05	
20 nests Griffin's glass beakers, No. 0 to 3	9 50	
6 4-qt. stoneware water-pitchers	2 00	
1 gal. black asphaltum varnish	80	
25 lbs. No. 6 lead shot	1 50	
1 Chesterman steel tape, 10 meters, divided on one side to millimeters	6 00	
¼ lb. rotten stone	05	
		20 00
Bill of John Taylor & Co.:		
1 doz. small compass jewels	$3 00	
10 lbs. soft glass tubing, ½" No. 2, medium thickness, in at least 3 ft. lengths	4 50	
3 2-qt. agate-ware water-pitchers	1 65	
3 1½-qt. agate-ware water-pitchers	1 35	
2 doz. wide-mouth, glass-stoppered bottles, 8 oz.	2 50	
1 gal. benzine	40	
3 small bots. vaseline	25	
¼ lb. copper oxide	15	
2 lbs. caustic potash, in sticks	90	
10 lbs. ammonium nitrate	2 00	
2 doz. crowfoot zincs, at 15c.	3 60	
1 flask mercury	41 00	
1 box adamantine candles, 20 sets, 14 oz., 6's	2 00	
1 small bot. glass cement	20	
		63 50
Expressage—Patterson & Co.		5 75
200 lbs. castings—Oakland Iron Works		8 00
50 lbs. castings—Oakland Iron Works		2 50
2 Fairbanks' trip scales—Fairbanks, Morse & Co.		7 50
1 doz. No. 56 magnifiers—Nordman Bros.		3 00
1 flannel buff—Nordman Bros.		50
1 felt wheel—Nordman Bros.		60
1 bristle wheel—Nordman Bros.		45
1 brush—Nordman Bros.		75
1 qt. wood polish—H. D. Kelsey		1 00
1 qt. laquer—H. D. Kelsey		1 35
Exchange of two calipers—C. F. Marwedel		75
2 lbs. ether—H. Bowman & Co.		1 80
3 rods round brass ⅛—Pacific Tool and Supply Co.		40
1 bar flat brass ¼" x ⅝"—Pacific Tool and Supply Co.		1 01
1 gross R. H. brass machine screws—Pacific Tool and Supply Co.		40
110 gals. coal oil—Pacific Tool and Supply Co.		16 50
Customs charges—C. D. Bunker & Co.		4 00
Freight—Southern Pacific Co.		2 40
Expressage—Patterson & Co.		50
36 pieces ¾x3¾x10 ft., T. & G. bd. cedar—Taylor & Co.		7 20
11 pieces ¾x3¾x12 ft., T. & G. bd cedar—Taylor & Co.		2 20
8 photos. of the normal spectrum of the magnesium arc—Northwestern University		3 00
520 lbs. ice—G. N. Martin		5 20
3 Morgan's mucilage pots and brushes—Payot, Upham & Co.		1 00
Bill of Bausch & Lomb Optical Co.:		
6 lenses, ¼" diameter	$4 50	
6 lenses, ½" diameter	4 50	
12 lenses, 2" diameter	7 20	
6 lenses, ¾" diameter	4 50	
4 lenses, 3" diameter	3 00	
	$23 70	
Less 25%	5 92	
		17 78
Expressage—Wells, Fargo & Co.		35
2 lbs. extra soft flowing spelter—Dunham, Carrigan & Hayden Co.		40
1 lb. pulverized borax—Dunham, Carrigan & Hayden Co.		15
1 quire sandpaper, each 00, 0, 1, 1½, 2—Dunham, Carrigan & Hayden Co.		65
3 Stubs' hack-saw blades, 8"—Dunham, Carrigan & Hayden Co.		69
1 8" B. & S. drop forge—Dunham, Carrigan & Hayden Co.		30

Department of Physics—Continued.

1 doz. plumb seals—Dunham, Carrigan & Hayden Co.		$0 50
1 Sunset shingling hatchet, No. 3.—Dunham, Carrigan & Hayden Co.		40
2 straight-shank twist drills—Dunham, Carrigan & Hayden Co.		1 20
1 gross brass wood screws—C. F. Marwedel		60
3 brushes—Chas. B Wells		1 00
225 lbs. ice—G. N. Martin		2 25
2 gross R. H. brass wood screws—Pacific Tool and Supply Co.		91
2 gross R. H. brass machine screws—Pacific Tool and Supply Co.		1 45
1 machine screw—C. F. Marwedel		32
11 hard brass rods, various sizes—C. F. Marwedel		7 90
50 lbs. copper sulphate—John Taylor & Co.		2 37
½ lb. manganese chloride, C. P.—John Taylor & Co.		35
3 LeClanche battery cells—John Taylor & Co.		2 55
3 German porcelain evaporating dishes, 7½″—John Taylor & Co.		1 35
3 German porcelain evaporating dishes, 6″—John Taylor & Co.		75
Expressage—Wells, Fargo & Co.		3 15
Expressage—Patterson & Co.		1 50
1 set M. S. taps and dies, No. 2—Pacific Tool and Supply Co.		5 20
3 gross round head wood screws, Nos. 2, 4, and 6—Pacific Tool and Supply Co.		1 15
5 gross fillister head screws, Nos. 2, 4, 6, 8, and 10—Pacific Tool and Supply Co.		2 09
2 gross round head machine screws, Nos. 6 and 8—Pacific Tool and Supply Co.		70
1 gross wood screws, No. 6, F. H.—Pacific Tool and Supply Co.		65
3 lbs. sulphuric ether—J. Caire Co.		2 10
10 lbs. paraffine—J. Caire Co.		1 05
10 lbs. tobacco foil—J. Caire Co.		1 90
1 5″ Rowland concave grating—J. A. Brashear		200 00
12 spools thread—Max Greenhood & Co.		50
1 Arkansas oilstone—Pacific Tool and Supply Co.		1 00
1 set hand-cut steel figures—Pacific Tool and Supply Co.		1 35
1 small countershaft—Pacific Tool and Supply Co.		2 25
6 ft. ⅛″ rubber tubing—Revere Rubber Tubing Co.		20
Expressage—Patterson & Co.		1 00
1 carboy sulphuric acid—John Taylor & Co.		4 41
Expressage—Patterson & Co.		1 85
Bill of J. Caire Co.:		
Wire, B. & S. standard wire gauge:		
2 lbs. No. 25 spring brass wire, B. & S. gauge	$0 57	
½ lb. No. 19 and ½ lb. No. 22 steel piano wire, B. & S. gauge	90	
2 lbs. 1″, No. 16 steel wire brads	20	
2 lbs. 1½″, No. 14 steel wire brads	15	
1 lb. 2″, No. 12 steel wire brads	08	
1 lb. 2″, No. 10 steel wire brads	07	
6 papers double-point, tinned tacks, No. 10	30	
2 cans commercial sulphuric ether, 3 lbs. each	4 32	
2 cans, ½ pt. Le Page's liquid glue	38	
2 pkgs. (200) cut filters (French or Amer.), 10″	50	
2 pkgs. (200) cut filters (French or Amer.), 7½″	36	
2 pkgs. (200) cut filters (French or Amer.), 6″	32	
2 gross corks, best quality, assorted sizes, from ¼″ to 1″ diam., larger end	60	
20 lbs. bichromate of potassium	3 00	
2 doz. wooden meter rods, divided to millimeters on one side, to inches and eighths on the other	7 80	
½ oz. platinum foil, No. 40 B. & S. gauge	9 00	
9½ cwt. platinum wire, No. 25 B. & S. gauge	6 65	
		35 30
Bill of John Taylor & Co.:		
1,000 Dennison's gummed labels, No. 209	$0 85	
1,000 Dennison's gummed labels, No. 201	85	
2 chamois skins, fine quality	1 60	
150 lbs. sulphate of copper	6 75	
3 lbs. gum shellac, best quality, yellow	1 20	
1 lb. gum shellac, best quality, white	50	
		11 75
8 6-oz. tubes black mimeograph ink—United Typewriter and Supplies Co.		4 80
2 blue record Remington ribbons—United Typewriter and Supplies Co.		1 20
10 rms. S. S. letter, punched—Dutton & Partridge		9 00
1 Reeve's wood pulley, 16x4x1$\frac{7}{16}$—Joshua Hendy Machine Works		1 65
1 piece ⅜ solid round belt, 12 ft.—Joshua Hendy Machine Works		1 20
6 16 candle 52 V. lamps—General Electric Co.		1 50
6 16 candle 110-V. lamps—General Electric Co.		1 50
10 key sockets—General Electric Co.		1 80
4 key sockets, wall—General Electric Co.		90
24 flat battery zincs, 1½″x 4″x ¼″—General Electric Co.		50

Department of Physics—Continued.

1 paint brush—Students' Coöp. Ass'n		$0 20
6 brass butts and screws—Schmitt & Zehner		30
2 doz. brass screws—Schmitt & Zehner		05
1 set hand-cut steel figures—Pacific Tool and Supply Co.		2 25
Expressage—Wells, Fargo & Co.		3 75
Expressage—Patterson & Co.		1 00
Marine insurance—Balfour, Guthrie & Co.		51
25 lbs. lead shot—J. Caire Co.		1 50
12 sets Griffin beakers, No. 0–2—John Taylor & Co.		3 00
2 rubber bulbs, open at one end—John Taylor & Co.		40
Bill of Pacific Tool and Supply Co.:		
Sawed strips hard brass, 2 strips each: $\frac{1}{16}$″x ¾″, 6 ft. long; ⅛″x ½″, 6 ft. long; ¼″x⅝, 6 ft. long; ¼″x¾″, 6 ft. long	$4 05	
1 round hard brass rod, 1″ diam., 10 ft. long	4 80	
1 piece hard square brass, ¾″ square, 6 ft. long	2 43	
1 piece hard square brass, 1″ square, 3 ft. long	2 07	
1 piece hexagonal brass, ½″, 6 ft. long	99	
Wire, B. & S. standard wire guage:		
2 lbs. No. 22, soft brass	54	
2 lbs. No. 16, soft iron	20	
2 lbs. No. 22, soft iron	20	
5 lbs. No. 14, soft copper, annealed	1 00	
Pure, soft, Norway iron:		
1 piece 6″ wide, ⅛″ thick, 3 ft. long	1 50	
1 piece 1″ wide, ¼″ thick, 6 ft. long	75	
1 piece sheet zinc, No. 20, B. & S. gauge, 3′x 6′	1 50	
Best hammered tool steel:		
1 piece, round, 1¼″ diam., 1 ft. long	1 15	
1 piece, round, 1″ diam., 1 ft. long	75	
1 piece, round, ¾″ diam, 1 ft. long	40	
1 Billings & Spencer drop-forged lathe dog, ⅜″	40	
1 Billings & Spencer drop-forged lathe dog, ½″	50	
1 Billings & Spencer drop-forged lathe dog, ¾″	55	
Standard hand reamers, 1 each: ⅛″, $\frac{3}{16}$″, $\frac{5}{16}$″, ⅜″, ½″, ¾″	8 75	
1 Morse taper reamer, No. 1, full length 5¼″, length of flute, 3½″	1 60	
1 hide-faced mallet, 1 lb. with extra faces	95	
1 hide-faced mallet, 2 lbs, with extra faces	1 15	
1 Morrill's saw set No. 1, improved	1 00	
1 round rod, aluminum, ¼″ diam., 3 ft. long	25	
1 sheet, $\frac{1}{16}$″ thick, 1 ft. x 2 ft., aluminum	1 75	
1 piece hard rubber, $\frac{1}{16}$″ thick, 1 ft. square	50	
2 pieces hard rubber, ⅛″ thick, 1 ft. x 2 ft.	2 00	
Milling cutters (Brown & Sharpe):		
1 spiral milling cutter, diam. 2¼″, width face 1″, hole ⅞″	2 60	
1 side cutter, diam. 2¾″, width face ⅜″, hole ⅞″	1 95	
1 screw slotting cutter, diam. 2¾″, hole ¾″, gauge 17	15	
1 screw slotting cutter, diam. 2¾″, hole ¾″, gauge 20	15	
1 metal slitting saw, diam. 2½″, thickness $\frac{1}{16}$″, hole ⅞″	75	
1 metal slitting saw, diam. 2½″, thickness ⅛″, hole ⅞″	75	
1 metal slitting saw, diam. 2½″, thickness $\frac{1}{32}$″, hole ⅞″	85	
2 lbs. assorted iron washers, $\frac{3}{16}$″ to ½″ hole	30	
1 doz. 8″ Griffin hack-saw blades, 22 teeth to inch	65	
1 half-circle sink, size No. 1, 24″ long, 14″ wide, finish, gray enamel	3 25	
Reeve's wood pulley: 1 12″ shifting, split, double arm, No. 1, width belt 2″, face 10″, exact size shaft, 1$\frac{7}{16}$″	2 15	
1 piece leather belting, 1″, single flat, 23 ft. long	1 38	
		56 66
Customs entry—C. D. Bunker & Co.		4 00
		$967 33

Appendix No. 17—*Department of Latin.*

	Marks.	
Bill of Mayer & Müller, in marks; total in dollars and cents:		
Müller, Ennius	8.00	
Cicero de Piubus	20.00	
Plautus, 5 vols.	71.75	
Draeger, Syntax	3.15	
	Mks. 102.90	$24 95
Mimeograph supplies—Clifton Price		7 50
		$32 45

APPENDIX No. 18—*Department of Greek.*

Hellenica, ed. by Abbott—Richardson & Co.		$2 74
Bill of Mayer & Müller, in marks; total in dollars and cents:	Marks.	
Platos Schriften von Wohlrab., VII	.60	
Christy, Platon. Studien	1.20	
Teuffel, Platon. Literatur	1.20	
Posto	.40	
Prinsteur, Prosopographia Platonica	2.60	
Posto	.30	
Schauz, Studien z. Geschichte Platon. Tentes	4.00	
	Mks. 10.30	2 50
3 copies Schreiber Class. Atlas—George M. Richardson		19 05
1 copy Jones' Anc. Writers, Greek Sculpture—George M. Richardson		2 17
		$26 46

APPENDIX No. 19—*Department of Mathematics.*

Bill of H. Welter, in francs; total in dollars and cents:	Francs.	
Darboux, Lecons s. l. theorie gen. des sur	47.50	
Jordan, Course d'analyse tome, 3 vols.	29.50	
Konigs. Lecons cinimatiques	10.20	
Lecons de l'aggregation classique de mathematique	12.00	
Borel, Brachet et Tannery, Instruction a l'étude de la theorie des nombres et de l'algebra	11.00	
Demartres, Course d'analyse, parts 1, 2	23.30	
	138.90	
Commission	8.70	
	Fcs. 147.60	$28 94

APPENDIX No. 20—*Department of Botany.*

Customs charges—C. D. Bunker & Co.	$4 00
Expressage—Wells, Fargo & Co.	60
Expressage—Wells, Fargo & Co.	2 15
Expressage—Patterson & Co.	25
Postage stamps—John McCarthy, P. M.	10 00
1 No. 4 postal scale—Wilshire Safe and Scale Co.	6 15
1 doz. straight steel needles—Henry Kahn & Co.	60
1 oz. cover glasses, circles—Henry Kahn & Co.	1 08
1 oz. cover glasses, square—Henry Kahn & Co.	78
1 gross glass slips—Henry Kahn & Co.	90
12 glass rods—Henry Kahn & Co.	36
1 balsam bottle—Henry Kahn & Co.	20
1 double nose-piece—Henry Kahn & Co.	3 75
1 rm. Westlock folio—Dutton & Partridge	3 40
2 No. 8 waste baskets—Dutton & Partridge	83
1 quire blotting paper—Dutton & Partridge	1 75
3 lbs. B. C. twine—Dutton & Partridge	75
3 lbs. B. C. twine, No. 18—Dutton & Partridge	75
3 lbs. cotton twine—Dutton & Partridge	59
1 doz. glycerine jelly jars—Abramson-Heunisch Co.	50
6 8-oz. flint ointment pots—Abramson-Heunisch Co.	63
6 16-oz. flint ointment pots—Abramson-Heunisch Co.	1 12
6 1-lb. jam jars—Abramson-Heunisch Co.	62
6 8-oz. cond. jars—Abramson-Heunisch Co.	35
6 16-oz. cond. jars—Abramson-Heunisch Co.	50
2 salt mouth bottles—Abramson-Heunisch Co.	45
6 3¼ glasses—Abramson-Heunisch Co.	36
3 32-oz. red wide-mouth bottles—Abramson-Heunisch Co.	30
¼ gross 3 dr. homeo. vials—Abramson-Heunisch Co.	50
Corks for above—Abramson-Heunisch Co.	75
1 nest 3 beakers, 2 to 1½ ozs.—John Taylor & Co.	35
1 plain glass funnel, 4½″—John Taylor & Co.	20
⅓ lb. ¼″ glass tube—John Taylor & Co.	25
2 ft. I. R. tube, light—John Taylor & Co.	12
2 ft. I. R. tube, heavy—John Taylor & Co.	16
1 5″ file and handle—John Taylor & Co.	25
1 set cork-borers, ⅛″ to ½″—John Taylor & Co.	1 75
3 doz. taper corks, assorted—John Taylor & Co.	43
2 small burette spring clamps—John Taylor & Co.	50
1 4x4 battery jar—John Taylor & Co.	25
6 naturalist's tubes, ¾x2—John Taylor & Co.	20
6 naturalist's tubes, ½x2—John Taylor & Co.	17

Department of Botany—Continued.

2 doz. round wicks—C. C. Riedy		$0 15
12 ft. portable tubing—Thos. Day & Co.		1 20
2 gum sockets—Thos. Day & Co.		50
3 ozs. Anthony's neg. cotton—Langley & Michaels Co.		1 80
¼ lb. chloral hydrate—Langley & Michaels Co.		37
1 sheet asbestos—Sanborn, Vail & Co.		10
1 gross Est. pens—Sanborn, Vail & Co.		68
3 8-oz. gl. stop. bottles—J. Caire Co.		55
2 doz. 6-oz. ex. W. M. bottles—J. Caire Co.		1 00
6 tubes, ½″ diam.—J. Caire Co.		30
1 grad. cylinder, 250 cc.—J. Caire Co.		1 00
1 lb. chloroform—J. Caire Co.		85
1 lb. potash alum—J. Caire Co.		05
1 lb. carbolic acid, cryst.—J. Caire Co.		50
6 4″ glass pipettes, rubber bulb—J. Caire Co.		25
6 6″ glass pipettes, rubber bulb—J. Caire Co.		37
5,000 coin bags—A. Zellerbach & Sons		2 95
10,000 seed bags—A. Zellerbach & Sons		3 92
6 wood stools—Indianapolis Furniture Co.	$4 50	
6 pine tables—Indianapolis Furniture Co.	9 00	
	$13 50	
Less	25	13 25
1 volume "Sylva of North America"—Houghton, Mifflin & Co.		25 00
Expressage—Patterson & Co.		4 25
6 ½-pt. specimen jars—Abramson-Heunisch Co.		50
6 1-oz. salt mouths—Abramson-Heunisch Co.		75
6 4-oz. salt mouths—Abramson-Heunisch Co.		82
1 doz. 2-oz. French squares and corks—Abramson-Heunisch Co.		20
1 copper box with slide rack—J. Caire Co.		2 25
1 wooden vial rack—J. Caire Co.		40
10 rms. mounting paper—Cambridge Botanical Supply Co.		47 00
Postage stamps—John McCarthy, P. M.		10 00
Expressage—Wells, Fargo & Co.		25
Centuries VII and VIII, Fungi Columbiani—J. B. Ellis		12 00
Expressage—Wells, Fargo & Co.		1 00
Expressage—Patterson & Co.		50
6 gals. LePage's glue—J. Caire Co		8 40
6 Bausch & Lomb AA4 microscopes, with double nose-piece—C. C. Riedy		177 95
1 bbl. alcohol—Crown Distilleries Co.		25 14
Expressage—Wells, Fargo & Co.		25
Expressage—Patterson & Co.		5 50
2 doz. paper boxes, 15x11x6—A. Fleishhacker & Co.		2 00
2 doz. paper boxes, 15x11x3—A. Fleishhacker & Co.		1 70
2 doz. paper boxes, 11x7½x3—A. Fleishhacker & Co.		1 50
2 doz. paper boxes, 3½x3x1—A. Fleishhacker & Co.		80
3 doz. paper boxes, 3½x3x2—A. Fleishhacker & Co.		1 50
1 lb. pine nuts—J. Jacobs		35
Corn and beans—Congdon & Co.		10
Radish seed—Congdon & Co.		10
1 stamp, on handle—C. A. Klinkner & Co.		1 50
1 rm. 24x36 Manilla paper—Blake, Moffitt & Towne		1 80
1 qt. ink—E. P. Bancroft		85
Bill of John Taylor & Co.:		
2 doz. wash bottles, 16 oz. (similar to Queen & Co.'s pattern)	$9 00	
1 casserole (porcelain handle), 1,000 cc.	1 00	
6 beakers, 100 cc., with lip	48	
1 filter stand, hard wood, oiled (adjustable rack for 4 funnels)	1 15	
1 Wedgewood mortar and pestle (No. 3 Whitall & Tatum, 6″ across top)	70	
500 cc. pyroligneous acid	35	
1 lb. xylol, pure	65	
1 oz. methyl blue (Grübler's)	90	
1 oz. methylene blue (Grübler's)	85	
8 ozs. salicytate of soda	38	
1 lb. eau de labarraque	37	
1 oz. alcanna root	20	
		16 03
Customs charges—C. D. Bunker & Co.		2 00
200 specimens of California plants—S. B. Parish		20 00
Expressage—Patterson & Co.		1 25
Expressage—Wells, Fargo & Co.		25
5 slide boxes—Students' Coöp. Ass'n		50

Department of Botany—Continued.

2 doz. glass slides—Students' Coöp. Ass'n		$0 20
2 slide boxes—Students' Coöp. Ass'n		20
2 doz. glass slides—Students' Coöp. Ass'n		20
Expressage—Patterson & Co.		25
Bill of J. Caire Co.:		
4 flasks (chemical pattern), flat bottom, 1,000 cc.	$1 05	
½ gross test tubes (6″ high, 1″ diam.)	1 50	
6 beakers, 1,000 cc., with lip	1 50	
2 ribbed funnels, 5½″ diam.	35	
8 oz. potassium nitrate	20	
1 lb. chrome alum	25	
1 lb. sulphuric acid, conc., C. P.	25	
1 lb. nitric acid, conc., C. P.	25	
1 lb. hydrochloric acid, conc., C. P.	25	
1 lb. ether (Squibb's)	1 25	
1 lb. agar-agar	75	
6 sheets litmus paper, red	15	
6 sheets litmus paper, blue	15	
		7 90
Expressage—Patterson & Co.		25
Bill of C. C. Riedy:		
4 doz. salt mouths (iron mold), 4½″ high, 1⅜″ diam. of mouth	$3 50	
1 casserole (porcelain handle), 500 cc.	60	
3 museum jars No. 2600, Whitall & Tatum (12″ high, 3½″ diam.)	2 00	
4 doz. dropping bottles, rubber-top pipette, 1½″ high (Whitall & Tatum "urinary test")	7 65	
1 doz. balsam bottles, short capped with loose glass rod (similar to Queen & Co's pattern)	3 35	
6 glass dishes, 70 mm. diam.	1 40	
½ gross tube vials, 3″ high, 1″ diam., with corks	2 20	
4 ozs. potassium iodide (Merck's)	1 05	
1 oz. potassium permanganate	10	
4 ozs. potassium ferrocyanide	25	
8 ozs. sodium carbonate	20	
1 lb. glacial acetic (Merck's)	65	
500 cc. osmic acid (1% sol'n)	7 00	
500 cc. platinic chloride (1% sol'n)	3 00	
500 cc. clove oil	90	
2 ozs. aniline oil	35	
500 cc. kylol balsam	3 90	
1 oz. acid fuchsin (Grübler's)	90	
1 oz. grange G. (Grübler's)	60	
1 oz. Congo red	40	
2 grammes cyanin	2 00	
1 lb. formalin (Schering's)	1 25	
2 rolls absorbent cotton	60	
200 round filters, white, 10″ diam.	40	
1 oz. zinc chloro. iodide (Merck's)	1 05	
		45 30
		$508 08

APPENDIX No. 21—*Department of Biology.*

½ bbl. alcohol—C. Jost & Son	$15 77
1 gross 2-oz. vaseline bottles, with corks—C. C. Riedy	3 00
1 doz. Cutting jars—C. C. Riedy	75
1 gross long vials—C. C. Riedy	5 00
1 yd. bolting—Newman & Levinson	2 00
40 sheets 140 M. B., cut—Blake, Moffitt & Towne	2 40
Brass and copper wire—A. Erlandsen	60
1 flat file, with handle—A. Erlandsen	25
½ gross 7XX long corks—Abramson-Heunisch Co.	30
¼ gross 14XX long corks—Abramson-Heunisch Co.	40
¼ gross 12XX long corks—Abramson-Heunisch Co.	22
2 nets—Geo. W. Shreve	1 50
2 scissors sharpened—Wm. Hatteroth	50
1 lb. glass tubing, assorted—John Taylor & Co.	1 60
2 pr. 8″ N. P. tongs—John Taylor & Co.	80
2 2-gal. 9x9 museum jars—C. C. Riedy	3 80
1 gross short 8-dr. vials, with corks—C. C. Riedy	3 80
3 doz. Stender dishes, 2x1″—C. C. Riedy	3 75
1 set cryst. dishes, 2½ to 6—J. Caire Co.	1 35
5 lbs. formalin—J. Caire Co.	8 50
Expressage—Patterson & Co.	4 00
Black enamel—S. Wakeham	25

Department of Biology—Continued.

Brush—S. Wakeham		$0 15
Turpentine—S. Wakeham		70
1,000 gummed stickers—Schmidt Label and Lith. Co.		1 50
Teaming—P. Ells		1 00
1 plane—Edelman & Co.		2 50
1 try square—Edelman & Co.		40
1 rip saw—H. M. Dakin		2 00
1 hatchet—H. M. Dakin		70
1 screw-driver—H. M. Dakin		30
1 8″ hasp—H. M. Dakin		10
2 padlocks—H. M. Dakin		80
4 lbs. nails—H. M. Dakin		20
1 agate washbasin—H. M. Dakin		35
2 gal. iron buckets—H. M. Dakin		1 60
1 L. H. shovel—H. M. Dakin		1 00
Galv. wire screen—H. M. Dakin		45
1 lamp—Edelman & Co.		50
150 ft. lumber—Kerckhoff-Cuzner Mill and Lumber Co.		4 25
1 cross-cut saw—H. M. Dakin		2 00
2 lbs. 6d nails—H. M. Dakin		10
120 ft. lumber—Kerckhoff-Cuzner Mill and Lumber Co.		3 00
Teaming—P. Ells		25
6 yds. cheesecloth—Mrs. M. Christ		30
Bottles—Off & Vaughn		5 30
10 gals. distilled water—F. W. Braun & Co.		1 25
Expressage—Wells, Fargo & Co.		2 10
Freight—Southern Pacific Co.		25
2 fibre pairs—J. Leo		1 00
1 washtub—J. Leo		2 10
2 rake handles and ferrules—H. M. Dakin		60
Teaming—P. Ells		75
2 hanks sash cord—H. M. Dakin		1 50
Transfer baggage—San Diego and Coronado Transfer Co.		50
Rent—Geo. Foster		5 00
3 yds. oilcloth—J. A. Mathewson		75
Cocaine—G. C. Gearn		75
Freight—Southern Pacific Co.		62
Rent of row boat—J. L. Paulsen & Co.		4 50
Boat, one day—J. L. Paulsen & Co.		1 00
Rent of cottage—J. Seick		10 00
Wax, machine oil, etc.—E. Norman		70
1 net hoop—T. G. Schulze		1 00
Rent of sail boat—C. Johnson		10 00
6 qt. jars—Edelman & Co.		45
Teaming—P. Ells		1 00
Freight—Pacific Coast Steamship Co.		16 95
Expressage—Patterson & Co.		1 50
10 yds. cheesecloth—I. Gardner		40
30 yds. tapestry, sewed and laid—W. & J. Sloane & Co.		22 50
34⅚ sq. yds. Napier—W. & J. Sloane & Co.		20 90
1 slide box—Henry Kahn & Co.		1 20
2 doz. cells—Henry Kahn & Co.		40
1 doz. circles—Henry Kahn & Co.		95
26 yds. muslin—Salinger Bros.		10 60
25 yds. toweling—Salinger Bros.		2 50
1 microtome—Henry Kahn & Co.	$39 75	
2 microscopes—Henry Kahn & Co.	92 50	
	$132 25	
Less expressage	23 20	
		109 05
3 microscopes, Stand A—Henry Kahn & Co.		26 25
3 each: objectives ⅔x⅙—Henry Kahn & Co.		33 75
6 eyepieces—Henry Kahn & Co.		7 50
2 lbs. soft paraffine—C. C. Riedy		40
2 lbs. turpentine—C. C. Riedy		95
1 lb. xylol—C. C. Riedy		95
½ lb. cedar oil—C. C. Riedy		65
1 lb. oil cloves—C. C. Riedy		1 50
½ lb. chloroform, C. P.—C. C. Riedy		60
3 lbs. chloroform, commercial—C. C. Riedy		2 25
1 lb. glacial acetic acid—C. C. Riedy		60
1 gram haematin—C. C. Riedy		1 00
¼ oz. haematoxylin—C. C. Riedy		1 00

Department of Biology—Continued.

1 gross microscope slides, No. 3800—C. C. Riedy	$0 60
1 gross microscope slides, No. 3815—C. C. Riedy	70
1 lb. absolute alcohol, Squibb's—C. C. Riedy	45
Expressage—Wells, Fargo & Co.	23 20
Expressage—Patterson & Co.	1 00
Clerical work—H. B. Torrey	8 75
Storage charges, Avalon, Santa Catalina—Geo. Morris	3 50
6 rabbits—L. C. Beem	1 50
Expressage—Wells, Fargo & Co.	2 75
5 lbs. formalose—Richards & Co.	4 50
Traveling expenses, etc.—H. B. Torrey	5 00
Traveling expenses and specimens—H. B. Torrey	2 70
2 grams Merck's haematin—C. C. Riedy	2 00
1 bbl. alcohol—Crown Distilleries Co.	25 14
Expressage—Patterson & Co.	1 25
1 lb. chromic acid—C. C. Riedy	95
6 slide boxes—C. C. Riedy	50
1 gram osmic acid—C. C. Riedy	1 50
1 lb. clove oil—C. C. Riedy	1 25
Grinding and repairing knives—C. C. Riedy	1 50
Customs charges—C. D. Bunker & Co.	2 00
Expressage—Patterson & Co.	75
1 stove and 6 joints pipe—Schmitt & Zehner	4 55
Collar—Schmitt & Zehner	10
Elbow—Schmitt & Zehner	25
Thimble—Schmitt & Zehner	10
11 sharks—R. Johnson	5 00
15 lbs. formalin—C. C. Riedy	16 50
4 lbs. formalin—C. C. Riedy	5 20
5 pkgs. 4-oz. tacks—A. Erlandsen	25
1 animal cage—Mrs. W. A. Nord	50
6 papers tacks—A. Erlandsen	30
3 doz. screw eyes—A. Erlandsen	15
Traveling expenses—H. B. Torrey	1 10
23$\frac{1}{6}$ doz. eggs—Mrs. M. A. Helphinstine	4 63
Expressage—Patterson & Co.	1 50
Expressage—Patterson & Co.	25
	$532 33

APPENDIX No. 22—*Library*.

Customs charges—C. D. Bunker & Co.	$12 00
Expressage—Patterson & Co.	2 50
Freight—Southern Pacific Co.	25
One Bulletin de l' Herbier, 1895—H. Welter	4 15
One Annale de Chimie—H. Welter	1 52
Balance due on Electrician—Kenyon News and Postal Subscription Co.	2 00
Postage stamps—John McCarthy, P. M.	20 00

Bill of B. F. Stevens, in pounds, shillings, and pence; total in dollars and cents:

	£.	s.	d.	
Journal of Chemical Industry, Vol. 12		3	0	
English Illustrated Magazine, December, 1894		1	0	
Annals and Magazine, Natural History, January, 1895		5	0	
Postage on periodicals, second quarter, 1895		10	4	
Mathematical Society Proceedings, 504-8		6	8	
Commission		0	8	
Microscopical Quarterly, No. 148		10	0	
Mineralogical Magazine, No. 49		5	0	
Royal Society Phil. Trans., Vol. 185	1	2	6	
Royal Society Phil. Trans., B. pt. 2	1	3	2	
Commission		4	7	
Quarterly Journal of Mathematics, 107		5	0	
Royal Society Proceedings, No. 343		3	6	
	£5	0	5	24 60
Proceedings, 1895—Academy of Natural Sciences of Philadelphia				5 00
Heinrich's Buchverzeichness, 1894—Mayer & Müller				1 83

Bill of Mayer & Müller, in marks; total in dollars and cents:

	Marks.
Allmann, Tunicale	2.00
Baer, Ento. de Larve	1.30
Buttohle, Entur. d. Eizelle	16.00
Binding	2.50
Carus, Entur. d. Ascidien	2.00
Claparede, Anatomie Thiere	22.00

Library—Continued.

Bill of Mayer & Müller—Continued.	Marks.	
Costa, Osserv. fisiol, etc.	4.00	
Binding	.60	
Dewitz, Præparate	4.00	
Binding	50.00	
Fauna and Flora d. Golf. v. Neapel	------	
Fischer, Lyna	1.50	
Fol, Schlumd	2.00	
Giard, l'emhyayen	3.00	
Grobben, Doliolum, etc.	8.80	
Binding	.50	
Hertwiz, Entw. d. Cellulose	3.50	
Nerven. d. Medusen	14.00	
Binding	3.00	
Thering, Nerven. d. Mollusken	28.80	
Keferstein u. Ehlers. Zoöl. Beitrage	12.80	
Binding	2.00	
Kowalensky, Entw. d. einpacken. Ascidien	7.20	
Prophera Listeri	3.00	
Krohn, Gattung, etc.	1.80	
Krolin, la generat. et le derul., etc.	2.00	
Kupfer, Tunicala	5.00	
Binding	.90	
Latrille, Tuniciers	10.00	
Lowig, Tunicier	1.50	
McIntoch	1.50	
Metschnitorff, Studien v. Atlas	16.00	
Meyer, über die Salpen	3.50	
Binding	.60	
Perrier	2.10	
Binding	2 00	
Schwann, Mikroscopical Researches	6.00	
Semper, Epidermis der Ascidien	2.00	
Verwen, Allgem. Physiologie	12.00	
Claus, Entw. d. Medusen	16.00	
Binding	2.25	
Crustacean	9.60	
Binding	1.50	
Gegenbauer, Schwimny	3.20	
Binding	.60	
Haeckel, Siphonophorm	15.00	
Binding	2.25	
Hatschek, Anneliden	10.40	
Binding	1.50	
Keferstun, niedere Seetticere	5.00	
Binding	1.50	
Binding	3.80	
	Mks. 334.70	$81 16
Expressage—Patterson & Co.		75
Expressage—Wells, Fargo & Co.		9 96
Postage stamps—John McCarthy, P. M.		20 00
Expressage—Wells, Fargo & Co.		1 70
Expressage—Patterson & Co.		1 00
One Annales Philosophique T. V.—H. Welter		99
	s. d.	
Mathematical Society Proceedings, 509 to 517—B. F. Stevens	12 0	
Commission—B. F. Stevens	1 2	
Postage on periodicals, 3d quarter—B. F. Stevens	3 3	
	£0 16 5	4 00
California Illustrated Magazine, Dec., 1893—P. J. Healy		10
California Illustrated Magazine, Jan., 1894—P. J. Healy		2 50
California Illustrated Magazine, Feb., 1894—P. J. Healy		25
California Illustrated Magazine, Mar., 1894—P. J. Healy		25
California Illustrated Magazine, April, 1894—P. J. Healy		25
Four yds. tracing cloth—Students' Coöp. Ass'n		1 40
Bill of Kenyon News Co.:		
American Architect, Imperial edition	$10 10	
American Chemical Journal	3 40	
American Geologist	3 55	
American Journal of Mathematics	4 25	
American Journal of Philology	2 50	
American Journal of Psychology	4 25	

Library—Continued.

Bill of Kenyon News Co.—Continued.		
American Journal of Science	$5 00	
American Naturalist	3 65	
American Society of Civil Engineers	9 00	
Annals of Mathematics, University of Virginia	2 05	
Arena	2 60	
Art Amateur, with colored plates	3 50	
Astro-Physical Journal	3 90	
Atlantic Monthly	3 35	
Botanical Gazette	3 05	
Bulletin Geological Society of America	5 05	
California Architect	2 50	
Century Magazine	3 60	
Classical Review	2 60	
Cosmopolitan	95	
Decorator and Furnisher (Paid to December, 1896.)		
Education	2 65	
Educational Review	2 65	
Electrical Engineer, New York	2 50	
Engineering News	4 90	
Engineering Record	5 05	
Engineering and Mining Journal	4 00	
Forum	2 75	
Johns Hopkins Historical Studies	2 55	
Journal of American Chemical Society	4 25	
Journal of Association Engineering Societies	2 70	
Journal of Morphology	3 00	
Journal of Political Economy, Chicago	2 60	
Journal of Education, Boston	2 25	
Kindergarten Magazine	1 65	
Library Journal	5 05	
Modern Language Notes	1 45	
Monist	1 65	
Nation, New York	2 85	
New Education, Simpson & Co., New York	85	
New England Magazine	2 55	
North American Review	4 25	
Pedagogical Seminary (Vol. 3 due us.)		
Philosophical Review, New York	2 60	
Physical Review, New York	2 60	
Political Science Quarterly	2 60	
Popular Science Monthly	4 60	
Psychological Review	3 65	
Publishers' Weekly	3 05	
Railroad Gazette	4 00	
Review of Reviews	2 15	
School of Mines Quarterly	1 65	
School Review	1 40	
Scientific American and Scientific American Supplement	6 00	
Scribner's Magazine	2 60	
Yale Review	2 60	
(English)—		
Annals and Mag. of Natural History	7 50	
Athenæum	3 50	
Chemical News	4 25	
Dublin Review	5 00	
Economic Journal	5 50	
Electrician	7 00	
Engineer	8 10	
Engineering	8 10	
Gardener's Chronicle	3 60	
Geological Magazine	4 40	
Journal of Anatomy and Physiology	6 00	
Journal of Physiology	5 50	
Longman's	1 75	
Macmillan's	2 65	
New Review	3 00	
Observatory and Companion	3 00	
Philosophical Magazine	7 75	
Temple Bar	3 00	
		$275 10
B. M. General Catalogue, 5 parcels; Subscription Catalogue, 1895, and commission—E. G. Allen, £3 15s. 5d.		17 99

Library—Continued.

Bill of Charles S. Greene, for periodicals for one year, beginning January, 1896:

Critic	$2 90	
Harper's Monthly	3 15	
Mining and Scientific Press	2 40	
Overland	2 50	
Pacific Rural Press	2 40	
Blackwood, Contemp. Edinburgh Quarterly, Fortnightly, Ninteenth Century, Scottish and Westminster Reviews	27 35	
	$40 70	
Harper's for December, 1895	30	
		$41 40
Expressage—Wells, Fargo & Co.		45
Expressage—Patterson & Co.		25
Freight—Southern Pacific Co.		84
American Economic Ass'n Transactions, Vol. 9—Macmillan & Co.		4 00
Annals, Vols. 7 and 8—American Academy of Political and Social Science		5 00

Bill of B. F. Stevens, for periodicals, in pounds, shillings, and pence; total in dollars and cents:

	£.	s.	d.	
Chemical Society Journal, 1896	2	2	0	
English Catalogue, 1896		5	0	
Journal of Chemical Industry, 1896	1	10	0	
Messenger of Mathematics, 1896		12	6	
Mind		12	0	
Nature, 1896, and postage	1	8	0	
Economic Review, 1896, and postage		10	0	
	£6	19	6	34 18
Two copying books—Dutton & Partridge				1 60
One ream Manilla paper—Blake, Moffitt & Towne				2 75
Hinrich's Katalog—Mayer & Müller				1 81

Bill of Mayer & Müller, in marks; total in dollars and cents:

	Marks.	
Goethe Jahr., Bd. 16		
Jahresber. d. chem. Techlologie, Bd. 40	19.20	
Binding	2.25	
Jahresber. Zoölogy, f. 1894	21.60	
	Mks. 43.05	10 44
Expressage—Wells, Fargo & Co.		30
Expressage—Patterson & Co.		25
Library blanks—Filmer-Rollins Electro Co.		3 00
Freight—Southern Pacific Co.		18 20
Expressage—Wells, Fargo & Co.		7 35
Expressage—Patterson & Co.		3 50
Freight—Southern Pacific Co.		4 35

Bill of Mayer & Müller, in marks; total in dollars and cents:

	Marks.
Philologie, Bd. 53	3.60
Fortschrifte d. Physik	27.00
Civilinginieur, 1894	15.50
Adatom. Anzeiger. Bd. IX	6.30
Jahrbuch f. Pædagogik	5.40
Memoires de l' Acad. de St. Petersburg	3.15
Jahrbuch d. Berg u. Hüttenwesen	7.20
Anatom. Anzeiger Erganzungsheft, Bd. X	3 60
Acta Mathematica, 11	13.50
Anglia, 18	18.00
Annalen Mathematio., 46	18 00
Annalen u. Physik	32.40
Beiblätter dazu	18.00
Verhandlungen d. Physik	3.60
Annali Matemativa, 23	14.40
Anzeiger Anatomischer	14.40
Arbeiten d. Gesundheitsamts.	18.90
Archiv Mathematik	9.45
Archiv neuere Sprachen	14.40
Archiv Physiologie Bd.	90.00
Bannen neue.	6.50
Berichte der chem. Gesellshaft	36.00
Bibliotheca Mathemativa	3.60
Blatter Rhein f. Erziehung	7.20
Centralblatt f. Agricultur	18.00
Centralblatt Biologisches	18.00

Library—Continued.

Bill of Mayer & Müller—Continued.	Marks.	
Centralblatt Botan	25.20	
Centralblatt Chemisches	54.00	
Centralblatt Literarisches	27.00	
Civilinginieur	13.50	
Crelles Journal f. Mathematik	10.80	
Dingler s Journal	32.40	
Estia	22.00	
Forschungen d. Agriculturphysik	17.10	
Gartenlaube	3.60	
Giornale Vinicole	12.00	
Jahrbuch d. geolog. Reichsanstalt	14.40	
Jahrbuch v. Mathematik	28.80	
Jahrbuch f. Mineralogie. Beilage	13.00	
Jahrbuch Mineralogie	36.00	
Jahrbucher f. Philologie	27.00	
Jahresbericht d. Alterthem	28.80	
Industrie Chemische	18.00	
Journal f. Praktische Chemie	21.60	
Register zu 1870–74	8.10	
Lehrproben u. Lehrgänge	3.60	
Literaturblatt f. germ. Philologie	10.00	
Museum f. Philologie Rhein	12.60	
Nachrichten Astronom	15.00	
Paleontographica	54.00	
Paul & Braune Beitrage	15.50	
Peterman. Mitheilungen	21.60	
Philologus, Bd. 54	15.30	
Revueil d. travaux Chimiques	10.50	
Rundschau deutsche	21.60	
Skizzenbuch f. d. prakt. Maschienenkonstruction	9.00	
Studien Englische	15.50	
Studien Philosophische	10.80	
Über Land und Meer	8.10	
Verhandlung d. Geverbefleiss	27.00	
Versuchsstationen Landwirtschaftl	10.80	
Vierteljahresschrifft Philosophie, 29.19	10.80	
Vierteljahresschrifft f. Chemie	11.70	
Weinlaube	12.00	
Zeitschrift f. deutsches Alterthum	16.20	
Zeitschrift f. Berg, etc	18.00	
Zeitschrift Oester. f. Berg, etc	21.60	
Zeitschrift f. angew. Chemie	18.00	
Zeitschrift f. anorg. Chemie	21.60	
Zeitschrift f. physikal Chemie	25.20	
Zeitschrift f. morgenl. Gesellschaft	13.50	
Zeitschrift Historische	10.15	
Zeitschrift d. Vereins deutscher Ingenieure	28.80	
Zeitschrift d. Oester. Ing. Vereins	18.00	
Zeitschrift f. Instrumentenkunde	18.00	
Zeitschrift f. Krystallographie	36.00	
Zeitschrift f. Mathemat. 1895. Suppl	6.85	
Zeitschrift f. Nahrungsmittel-Unter	9.00	
Zeitschrift f. deutsche Philologie	13.50	
Zeitschrift romanische Philologie	18.00	
Zeitschrift Philosophie	10.80	
Zeitschrift f. Psychologie	40.50	
Zeitschrift vergl. Sprachforschung	14.40	
Zeitschrift math. naturw. Interricht	10.80	
Zeitschrift Zoölogie	72.90	
Zeitung Berg & Hüttenmann	23.40	
Zeitschrift f. analyt. Chemie	32.40	
Porto f. Zeitschriften	215.10	
	Mks. 1,831.50	$444 14
2,000 envelopes—M. Brown & Sons		9 00
Library notes, Vol. 4—Kenyon News Co.		90
Bill of H. Welter:	Francs.	
Annales de Chimie	36.00	
C. R. des Sciences	35.00	
C. R. des Sciences, mor. and polit	27.00	
Journal des économistes	39.00	
Journal de Mathematique	35.00	
Revue des Mondes	61.00	

Library—Continued.

	Francs.	
Bill of H. Welter—Continued.		
Revue Philosophique	35.00	
Revue Scientifique	36.50	
Romanie	23.00	
Revue gen. de botanique	22.50	
Progres agricole and viticole	14.50	
Thirteen packets	3.25	
	Fcs. 367.75	$72 11
Postage stamps—John McCarthy		20 00
Expressage—Patterson & Co.		25
Annual Literary Index, 1895—Publishers' Weekly		3 50
Postage—Publishers' Weekly		18
Proceedings of the Boston Society of Natural History		4 00
Expressage—Wells, Fargo & Co.		6 40
Expressage—Patterson & Co.		1 25
Southern Pacific Co.		25
Postage on periodicals, October, 1895, to March, 1896—B. F. Stevens		1 24
Transactions Am. Philol. Ass'n, Vol. 26—Ginn & Co.		2 00
Academy, July 13, 1895—Kenyon News and Postal Subscription Co.		10
Economist, 1:4:96—Kenyon News and Postal Subscription Co.		20
Notes and Queries, index to Vol. 8—Kenyon News and Postal Subscription Co.		15
Saturday Review, 1:11:96—Kenyon News and Postal Subscription Co.		15
Spectator, 1:18:96—Kenyon News and Postal Subscription Co.		15
Expressage—Wells, Fargo & Co.		35
Expressage—Patterson & Co.		1 50
		$1,198 34

APPENDIX No. 23—*Museum*.

½ bbl. alcohol—C. Jost & Son	$15 78
2 coils wire—Schmitt & Zehner	20
2 spools copper wire—Schmitt & Zehner	20
6 doz. iron screw-hooks, assorted—Schmitt & Zehner	30
4 doz. brass cap hooks—Schmitt & Zehner	60
Awl handle—Schmitt & Zehner	10
4 awls—Schmitt & Zehner	05
1 lb. brads—Schmitt & Zehner	10
2 gimlets—Schmitt & Zehner	20
96 blocks—G. C. Pape	4 00
3 tables—H. Schellhaas	6 00
5 papers assorted tacks—Schmitt & Zehner	25
Assorted galv. and copper wire—Schmitt & Zehner	45
1 B. B. X. Continental microscope—Henry Kahn & Co.	45 00
1 camera lucida—Henry Kahn & Co.	8 25
1 dissecting microscope—Henry Kahn & Co.	8 25
1 paraffine bath—Henry Kahn & Co.	5 00
2 sets Bohemian cryst. dishes—C. C. Riedy	3 50
2 capped balsam bottles—C. C. Riedy	50
2 capped glass-stemmed bottles—C. C. Riedy	50
½ gross long 8-dram. vials—C. C. Riedy	1 50
¼ gross 8-dram. vials—C. C. Riedy	75
Glass-stoppered tincture bottles, 6 each: 1 qt., 1 pt., ½ pt., ¼ pt.—C. C. Riedy	3 60
8 iron brackets—W. T. Veitch & Bro.	7 00
Expressage—Patterson & Co.	75
1 cylinder graduate 100 cc.—J. Caire Co.	1 90
1 lb. caustic potash, commercial—J. Caire Co.	12
10 ft. rubber tube, ⅞—J. Caire Co.	90
19 yards cheesecloth—Max Greenhood	75
1 gross XX corks—C. C. Riedy	40
1 oz. haemotxylin, Delafield's—C. C. Riedy	20
4 oz. haemotxylin, Ehrlich's—C. C. Riedy	40
1 grm. xylol—C. C. Riedy	30
1 grm. Canada balsam—C. C. Riedy	30
1 condenser for microscope—C. C. Riedy	5 75
2 lenses—C. C. Riedy	3 00
1 doz. staining jars—C. C. Riedy	2 25
¼ gross short vials—C. C. Riedy	75
Expressage—Patterson & Co.	1 00
Freight—Southern Pacific Co.	2 40
1 bbl. alcohol—Crown Distilleries Co.	25 14
Expressage—Patterson & Co.	1 00
1 cylinder graduate, 25 cc.—John Taylor & Co.	33
1 porcelain evaporating dish, 4″—John Taylor & Co.	18
1 porcelain evaporating dish, 5″—John Taylor & Co.	25

Museum—Continued.

1 porcelain evaporating dish, 6″—John Taylor & Co.		$0 37
2 chemical thermometers—John Taylor & Co.		1 20
1 iron tripod, 2 ring—John Taylor & Co.		35
1 Bunsen burner, with movable collar—John Taylor & Co.		30
1 wood support—John Taylor & Co.		90
1 ¼-gal. glass funnel—John Taylor & Co.		28
Customs charges—B. D. Bunker & Co.		2 00
Marine insurance—Balfour, Guthrie & Co.		44
Customs charges—C. D. Bunker & Co.		4 00
Expressage—Patterson & Co.		1 00
Bill of J. R. McDonald & Co., in marks; total in dollars and cents:	Marks.	
10 pieces square preparation glasses, 4 cm. deep, 13 cm. high, 12 cm. broad	22.50	
15 pieces square preparation glasses, 5 cm. deep, 20 cm. high, 16 cm. broad	120.00	
10 pieces square preparation glasses, 3 cm. deep, 15 cm. high, 6 cm. broad	15.00	
10 pieces square preparation glasses, 3 cm. deep, 15 cm. high, 8 cm. broad	18.00	
5 pieces square preparation glasses, 8 cm. deep, 36 cm. high, 5 cm. broad	45.00	
	Mks. 220.50	
Discount, 15%	33.05	
	Mks. 187.45	
Packing, freight, etc.	67.95	
Commission	12.77	
	Mks. 268.17	65 03
Work as janitor—W. C. Maxwell		4 30
		$240 32

APPENDIX No. 24—*University Printing Office.*

Expressage—Patterson & Co.		$2 25
$\frac{1}{16}$ lb. 8-point Ronaldson fractions—Pacific States Type Foundry		22
¼ rm. mourning note—Blake, Moffitt & Towne		75
2 rms. 24x36 S. S. & C. tint, cut ¼—Blake, Moffitt & Towne		8 96
1 rm. 24x36, 65 lb. tint, cut ¼—Blake, Moffitt & Towne		5 20
2 rms. 28 Whiting folio—Blake, Moffitt & Towne		8 96
2 rms. 16 Whiting cap—Blake, Moffitt & Towne		5 12
100 sheets 120 cream M. B.—Blake, Moffitt & Towne		4 50
3 rms. 20x42 70 S. S. & C. tint—Blake, Moffitt & Towne		16 80
200 sheets 50 silver gray cover—Blake, Moffitt & Towne		1 60
Expressage—Patterson & Co.		25
Expressage—Patterson & Co.		5 75
5,000 No. 9 envelopes—Blake, Moffitt & Towne		6 00
5,000 No. 10 envelopes—Blake, Moffitt & Towne		6 90
50,000 tag board—Blake, Moffitt & Towne		2 25
6,000 tag board, 5½x4¾, perforated—Blake, Moffitt & Towne		10 50
Expressage—Patterson & Co.		3 00
1 paper-knife ground—Will & Finck		75
11 yds. Canton flannel—Strauss & Baum		1 00
Bill of Palmer & Rey Type Foundry:		
25 lbs. 6-pt. French Old Style	$13 50	
25 lbs. 12-pt. French Old Style (No. 2 Central)	9 50	
25 lbs. 30-pt. Latin Antique	12 50	
25 lbs 36-pt. Latin Antique	12 50	
1 font 48-pt. Latin Antique	7 70	
1 font 6-pt. Tudor Black	2 25	
1 font 8-pt. Tudor Black	2 75	
1 font 10-pt. Tudor Black	2 75	
1 font 18-pt. Tudor Black	3 40	
1 font 72-pt. De Vinne (caps only)	10 00	
1 font 24-pt. No. 1 Steelplate Script	4 00	
1 font 24-pt. No. 2 Steelplate Script (lower case)	2 00	
1 font 8-pt. piece fractions	3 60	
1 font 10-pt. piece fractions	2 80	
1 each brass braces, from 11 to 17, inclusive	2 25	
2 No. 2 lye brushes	80	
1 small bellows	90	
1 8″ reversible nickel composing stick	1 55	
1 tin reducing compound	50	
1 box boxwood quoins	75	

University Printing Office—Continued.

Bill of Palmer & Rey Type Foundry—Continued.		
1 Reference Manual	$0 50	
1 doz. yards pica reglet	35	
6 yards each 2 and 4 line reglet	60	
3 yards each 6 and 8 line reglet	42	
1 overlay knife	50	
		$98 37
1 rm. 28x42, S. S. & S. tint—Blake, Moffitt & Towne		5 60
1½ rm. 24x38, S. S. & S. tint; ½ rm. S. S. & S. tint—Blake, Moffitt & Towne		10 40
2 rms. 28 Ashland folio—Blake, Moffitt & Towne		7 28
2 rms. 24 Ashland folio—Blake, Moffitt & Towne		6 24
2 half-med. rollers, recast—E. J. Shattuck & Co.		2 00
2 quarter-med. rollers, recast—E. J. Shattuck & Co.		1 50
1 brayer, recast—E. J. Shattuck & Co.		50
3 eighth-med. rollers, recast—E. J. Shattuck & Co.		1 50
1 lb. fine black job ink—E. J. Shattuck & Co.		1 00
1 lb. black job ink—E. J. Shattuck & Co.		75
Binding 1,700 Freshman lists—J. B. McIntyre		1 50
840 record cards—Blake, Moffitt & Towne		22 60
Expressage—Patterson & Co.		2 65
1 rm. mourning note—Blake, Moffitt & Towne		3 00
250 envelopes—Blake, Moffitt & Towne		40
7 lbs. 8-pt. O. S. No. 8—Palmer & Rey Type Foundry		2 75
20,000 enrollment cards—Blake, Moffitt & Towne		25 64
6,000 registration cards—Blake, Moffitt & Towne		10 85
200 sheets 120 M. B., cut—Blake, Moffitt & Towne		8 00
2 rms. 24 Ashland folio—Blake, Moffitt & Towne		6 24
2 rms. 28 Ashland folio—Blake, Moffitt & Towne		7 28
2 rms. 28 Whiting folio—Blake, Moffitt & Towne		8 96
10,000 No. 6 Manilla envelopes—Blake, Moffitt & Towne		6 00
150 8½x15 covers—Blake, Moffitt & Towne		40
1½ lbs. bour. sorts—Palmer & Rey Type Foundry		60
Expressage—Patterson & Co.		2 00
1 lb. job ink—E. J. Shattuck & Co.		50
2 med.—E. J. Shattuck & Co.		1 00
1 lb. bond black—E. J. Shattuck & Co.		1 00
2 rms. 24x38, S. S. & C. tint, cut and trimmed—Blake, Moffitt & Towne		9 75
2 rms. 24 Ashland folio—Blake, Moffitt & Towne		6 24
2 rms. 28 Ashland folio—Blake, Moffitt & Towne		7 28
2 rms. 28 Whiting folio—Blake, Moffitt & Towne		8 96
2 rms. 24x38, 44 folded, cut in half—Blake, Moffitt & Towne		6 00
1 rm. 24x36, 40-lb. No. 1 Manilla—Blake, Moffitt & Towne		2 40
5 lbs. cotton twine—Blake, Moffitt & Towne		85
1 rm. 20-lb. Japanese linen folio—Blake, Moffitt & Towne		5 04
1 rm. 24-lb. Japanese linen folio—Blake, Moffitt & Towne		6 05
100 sheets M. B., cut—Blake, Moffitt & Towne		4 50
Expressage—Wells, Fargo & Co.		25
Expressage—Patterson & Co.		1 50
Expressage—Patterson & Co.		75
Bill of Blake, Moffitt & Towne:		
3,000 sheets cream note	$19 50	
3,000 inside envelopes	28 50	
3,000 outside envelopes	10 80	
	$58 80	
Less 20%	11 76	
	$47 04	
1 rm. Parson's medium, cut	7 20	
		54 24
Expressage—Patterson & Co.		75
55 sheets Whiting folio, cut—Blake, Moffitt & Towne		40
3 rms. Vesta folio, cut—Blake, Moffitt & Towne		4 80
2 rms. 24x38 S. S. & C. tint—Blake, Moffitt & Towne		9 75
1 rm. 28x42 S. S. & C. tint—Blake, Moffitt & Towne		5 25
Expressage—Patterson & Co.		50
1 2-H.P. multipolar, shunt-wound motor, starting box, pulley, and belt tightener, 1,200 r. p. m.—Westinghouse Electric and Mfg. Co.		115 00
75 sheets 120 M. B. cream, cut—Blake, Moffitt & Towne		3 50
1 lb. bond black—E. J. Shattuck & Co.		1 00
1 lb. book black—E. J. Shattuck & Co.		50
1 lye brush—E. J. Shattuck & Co.		40
3 eighth-med. rollers, recast—E. J. Shattuck & Co.		1 50

University Printing Office—Continued.

3 quarter-med. rollers, recast—E. J. Shattuck & Co.	$2 25
1 brayer roller, recast—E. J. Shattuck & Co.	50
Expressage—Patterson & Co.	2 25
	$599 43

APPENDIX No. 25—*University Site Improvement.*

Labor, month of June, 1895		$263 00
Repairing mower—Nelson & McLellan		1 00
Repairing wagon-brake—Nelson & McLellan		75
8 horseshoes—Nelson & McLellan		4 00
Labor, month of July		265 80
6 picks repaired—Nelson & McLellan		2 10
8 horseshoes—Nelson & McLellan		4 00
Labor, month of August, 1895		280 00
10 bbls. White's cement—Henry Cowell & Co.		34 00
Labor, month of September, 1895		254 00
1 ton rolled barley—Congdon & Co.		15 00
½ ton bran—Congdon & Co.		7 00
1 set best Concord harness—Frank C. Howe		40 00
Culvert across Oxford Street—C. A. Miller		904 00
Labor, month of October		276 00
Repairing four picks—Nelson & McLellan		3 00
8 horseshoes—Nelson & McLellan		4 00
6 Ames' shovels—A. Erlandsen		7 20
4 Phœnix Canariensis—California Nursery Co.		28 00
Labor, November, 1895		268 00
355 ft. 2″ drain tile—Gladding, McBean & Co.		7 10
Blacksmithing—Nelson & McLellan		7 50
Labor, December, 1895		253 00
Labor, January, 1896		268 00
6 blue prints of map of grounds—San Francisco Blue Print Co.		5 00
Blacksmithing—Nelson & McLellan		5 35
Labor, February, 1896		260 00
10,210 lbs. hay—George Mulholland		50 00
Blacksmithing—Nelson & McLellan		1 75
Making new road, etc., as follows:		
Expressage—Patterson & Co.	$4 50	
25 picks—Pierce Hardware Co.	17 70	
25 pick handles—Pierce Hardware Co.	5 83	
Expressage—Alex. Sharp	19 15	
Use of team and men, 4 days—J. J. Dunn	33 00	
1 crowbar—J. J. Dunn	1 45	
Labor, 28 days—John McCallum	72 25	
Labor and use of team, 2½ days—M. L. Gray	20 00	
Labor and use of team, 7 days—Robert J. Carter	23 50	
Labor and use of team, 4 days—E. J. Gordon	13 00	
Labor and use of team, 2½ days—J. N. Jacobson	10 00	
Labor and use of team, 2½ days—A. C. Jacobson	10 00	
Labor and use of team, 1½ days—J. C. Isherwood	6 00	
Labor and use of team, 5 days—R. Davis	20 00	
Labor and use of team, 2½ days—F. L. Manning	10 00	
Labor, 5 days—James Stutt	10 00	
Labor and use of team, 4 days—John Stutt	16 00	
Labor and use of team, 2 days—George Schmidt	17 00	
Labor and use of team, 4 days—R. Moore	16 00	
Hauling rock—R. Moore	16 00	
Labor, with team, 4 days—George Stutt	16 00	
Labor, with team, 3½ days—W. McGuire	14 00	
Labor, with team, 1½ days—George McClellan	6 00	
Lowering gas service, North Hall—Oakland Gas L. & H. Co.	10 50	
		387 88
6 garden hoes—A. Erlandsen		2 00
6 scythes—A. Erlandsen		3 75
Grading around North Hall		97 00
Labor, April, 1896		268 00
Blacksmithing—Nelson & McLellan		4 00
210 lbs. hay—George Mulholland		1 05
12½ lbs. orchard grass seed—Trumbull & Beebe		2 50
Finishing work around North Hall, filling in soil, guttering and grading walks, etc., and finishing road to Mechanics' building—George Stutt		145 00
Plastering around North Hall, and concrete work—J. A. Marshall		50 00
48″x300′ 2″ 16 galv. netting—California Wire Cloth Co.		13 20
2 lbs. 1″ 12 galv. staples—California Wire Cloth Co.		16

University Site Improvement—Continued.

Hauling one load wheelbarrows to Golden Gate Park—People's Express and Transfer Co.	$12 00
35 lbs. Australian rye seed—Trumbull & Beebe	3 50
5 lbs. orchard grass—Trumbull & Beebe	1 00
2 lbs. Kentucky blue grass—Trumbull & Beebe	50
20 lbs. Australian rye grass seed—Trumbull & Beebe	2 00
300 sq. ft. galv. wire netting and staples—A. Erlandsen	1 65
Blacksmithing—Nelson & McLellan	6 55
1 6x6x16 post and 1 bolster—Johnson & Cavan	2 50
24 pieces 2x4 8 ft. pine, sawed—Johnson & Cavan	9 00
2 lbs galv. staples—A. Erlandsen	25
Expressage—Patterson & Co.	1 00
Labor, month of May, 1896	270 00
	$5,071 04

APPENDIX No. 26—*Department of Drawing.*

2 key blanks—Mark Everson		$0 50
3 whole pans, ord.—Students' Coöp Ass'n		45
2 whole pans, 3rds—Students' Coöp. Ass'n		80
1 whole pan, 4ths—Students' Coöp. Ass'n		64
1 whole pan, 5ths—Students' Coöp. Ass'n		95
1 W. & N. patent box—Students' Coöp. Ass'n		2 17
3 cases, 8 ft. long, 2 ft. 6 in. high, 3 ft. deep—W. T. Veitch & Bro.		105 00
8 whole pans water color—Students' Coöp. Ass'n		1 60
2 whole pans water color—Students' Coöp. Ass'n		80
1 microscope—Students' Coöp. Ass'n		50
1 pr. scissors—Students' Coöp. Ass'n		1 20
3 bots. Higgins paste—Students' Coöp. Ass'n		45
1 paper-knife—Students' Coöp. Ass'n		45
1 No. 20 Bradford stove, 3 joints stovepive and 1 elbow—M. De la Montanya		16 00
2 brushes—Bass-Hueter Paint Co.		1 25
1 bot. cadmium—Bass-Hueter Paint Co.		50
9 bots. Chinese white—Bass-Hueter Paint Co.		2 25
2 bots. Hooker's green—Bass-Hueter Paint Co.		50
1 roll blue print paper—Students' Coöp. Ass'n		1 50
Bill of H. S. Crocker Co.:		
2 W. & N. sables in Albata ebony handles, No. 4	$0 40	
1 W. & N. sable in Albata ebony handle, No. 6	25	
1 Dean's patent swivel and adjustment mahogany T square, 24″	1 75	
2 sponge rubbers, 2⅛″x3¼″x1″	50	
1 doz. Faber's white fringed erasers, No. 20	75	
6 Faber's kneaded rubber, No. 1224	40	
3 doz. Koh-inor pencils, each HB, 2B	2 55	
20 sheets buff blotting paper, 120 lbs., Climax	50	
500 Crane's bar envelopes, No. 1	1 80	
1 doz. wedding cream letter tablets, plain	3 00	
1 pr. 12″ Banker's shears, best	75	
1 doz. 3-oz. bots. Sanford's paste	85	
1 box Gillott's No. 303	80	
		14 30
Bill of Sanborn, Vail & Co.:		
1 fixed T square, mahogany, ebony lined, 18″	$0 41	
3 (22-yd. rolls) Albe tracing paper	3 75	
3 rolls 36″ Imperial tracing cloth	16 50	
3 rolls 36″ Johannot heavy blue print paper, in tubes	2 70	
6 drawing boards, 24x32″, sugar pine, walnut ends	5 10	
1 ream Crane's superfine commercial paper	2 15	
3 doz. wedding cream note tablets, plain	4 50	
12 Whatman's sketch blocks, C. P., 32 leaves each, 12x16	11 40	
12 Whatman's sketch blocks, rough, 32 leaves each, 12x16	11 40	
12 "Gem" sketch blocks, rough, C. P., 32 leaves each, 12x16	3 60	
6 1″ short chisel bristle brushes	60	
W. & N. water-proof ink, three each of scarlet, ultramarine, slate, brown, brick-red, burnt sienna	3 00	
2 qts. Carter's koal black ink	84	
		65 95
Bill of Schusler Bros.:		
Windsor & Newton's water colors, in whole pans, 2 of each: Carmine, Antwerp blue, ivory black, emerald green	$1 88	
Smalt	1 80	
French blue	75	
Light red	30	
Yellow ochre	30	
Indian yellow	60	
Cadmium yellow	75	

Department of Drawing—Continued.

Bill of Schusler Bros.—Continued.		
Gamboge	$0 30	
6 burnt sienna	90	
6 cobalt blue	2 25	
6 Vandyke brown	90	
2 glasses, for water	10	
1 roll 48″ Lick detail, No. 80, 70 lbs.	4 55	
6 soft erasers, No. 12	60	
300 No. 12 blotters (120 lbs.)	75	
1 white edge triangular scale, engineer's, 12″	2 00	
1 steel tape, 25-ft., Chesterman	3 67	
1 box Gillott's No. 404	40	
6 boxes assorted Soennecken pens	1 50	
		$24 30
Expressage—Patterson & Co.		2 00
		$244 05

APPENDIX No. 27.—*Department of Astronomy.*

Traveling expenses—A. C. Leuschner		$1 80
Services of telegraph operator—R. W. Gillette		3 00
Telegrams—Western Union Tel. Co.		8 55
Postage stamps—J. McCarthy, P. M.		2 00
Postage stamps—J. McCarthy, P. M.		5 00
1 letter file—Students' Coöp. Ass'n		50
Thumb tacks—Students' Coöp. Ass'n		95
Blotter—Students' Coöp. Ass'n		15
1 box rubber bands—Students' Coöp. Ass'n		15
½ ream Westlock demy 5½x8⅕, and ½ ream Westlock demy 8x10½—Dutton & Partridge		4 00
1,000 envelopes, No. 6—Dutton & Partridge		1 60
Repairing telegraph line—S. H. Metcalf		3 50
1 case Star oil—Jos. McClain & Co.		2 40
Broom—Jos. McClain & Co.		35
Expressage—Wells, Fargo & Co.		25
Penholders—Students' Coöp. Ass'n		30
Pens—Students' Coöp. Ass'n		05
Ink—Students' Coöp. Ass'n		15
13 window shades—Durgin & Bleakley		8 45
10 lbs. mercury—J. Caire Co.		5 80
40 strips, 9″ long each—S. C. Partridge		4 00
Clerical work—F. E. Ross		50 00
Expressage—Patterson & Co.		50
50 lbs. bluestone—F. V. Baer		4 00
1 gal. C. N. oil—F. V. Baer		75
Matches—Congdon & Co.		50
150 astronomy blanks—Hicks-Judd Co.		3 75
1,000 sheets paper, coördinate—Students' Coöp. Ass'n		4 60
Telegrams—Western Union Tel. Co.		25 32
2 lamp chimneys—J. McClain & Co.		60
1 wick—J. McClain & Co.		25
Postage stamps—A. O. Leuschner		1 50
1 case Star oil—Jos. McClain & Co.		2 40
Altering stone foundation for transit instrument—D. Dwyer		8 00
1 case coaloil—Jos. McClain & Co.		2 40
1 atlas, half morocco—Hicks-Judd Co.		3 25
Expressage—Wells, Fargo & Co.		25
Expressage—Patterson & Co.		25
1 doz. document boxes—Students' Coöp. Ass'n		70
Stamps—J. McCarthy, P. M.		2 00
Rental of stereopticon lantern—S. C. Partridge		25
	Marks.	
2 Berliner. Astronom. Jahrbüch, 1896—Mayer & Müller	19.20	
Binding Astronom. Jahrbüch	2.00	
Postage	1.90	
	Mks. 23.10	5 63
4 doz. mixed pen-points—Students' Coöp. Ass'n		20
1 qt. black writing fluid—Students' Coöp. Ass'n		40
Traveling expenses—F. E. Ross		45
Repairing wires—March Cycle and Elec. Works		4 50
2 cases coaloil—Jos. McClain & Co.		4 80
Expressage—Wells, Fargo & Co.		25
Telegrams—Western Union Tel. Co.		2 98
1 iron starting box—W. H. Lozier		4 00

Department of Astronomy—Continued.

4,000 No. 6 envelopes—Blake, Moffitt & Towne	$2 40
Telegram—Western Union Tel. Co.	25
Postage stamps—John McCarthy, P. M.	2 00
Expressage—Wells, Fargo & Co.	25
1 case Star oil—Jos. McClain & Co.	2 40
Boxes for lantern slides—A. H. Broad.	2 00
1 silver glass reflector—H. R. Sorenson	20
Bill of R. W. Lohmann & Co. for wiring the Observatory:	
1 McCraery desk lamp	45 45
3 18″ Almond flexible brackets	
3 6″ Almond flexible brackets	
7 keyed wall sockets	
1 three-light cluster, with 14″ porcelain shade	
5 key-sockets	
24 ft. No. 8 cotton lamp cord	
1 doz. miniature lamps	
1 10-amp. double-pole switch	
2 cord pendants	
1 5-amp. double-pole switch	
20 16 C. P. Ed. base incandescent lamps—R. W. Lohmann & Co.	5 00
5 frosted C. P. Ed. base incandescent lamps—R. W. Lohmann & Co.	1 75
Postage stamps—John McCarthy, P. M.	3 00
Telegrams—Western Union Tel. Co.	2 95
	$279 83

APPENDIX NO. 28—*Department of Decorative and Industrial Art.*

Expressage—Patterson & Co.		$8 00
1 roll hock—Uhl Bros.		1 75
17 yds. cheesecloth—Abrahamson Bros.		1 75
Display cards—H. S. Crocker Co.		1 50
Cotton batting—J. J. O'Brien & Co.		1 30
6 adjustable drawing stands, with hand wheels—Washburn Shops of the Worcester Polytechnic Institute		62 40
24 plaster casts, assorted—C. Hennecke & Co.	$47 78	
5 boxes, and packing—C. Hennecke Co.	3 20	
	$50 98	
Less	98	50 00
1 Terry liner—McCormick & Terry		5 00
1 14″ rule and brace—McCormick & Terry		1 50
3 frames—Kidder & Cooper		7 50
Expressage—Wells, Fargo & Co.		
22 frames—W. K. Vickery		44 00
Hooks, wires, etc.—W. K. Vickery		1 00
Expressage—Patterson & Co.		20 65
Freight—Southern Pacific Co.		14 04
Expressage—Patterson & Co.		9 50
3 dozen picture hooks—A. Erlandsen		45
Door knobs—A. Erlandsen		20
Traveling expenses—H. T. Ardley		2 00
Expressage—Patterson & Co.		25
Postage stamps—John McCarthy, P. M.		9 00
1,000 envelopes, printed—Dutton & Partridge		2 90
1,000 letterheads, printed and ruled—Dutton & Partridge		6 25
1,000 noteheads, printed and ruled—Dutton & Partridge		
2 drafting boards—Kidder & Cooper		3 00
1,000 booklets, "Industrial Art in Education"—Oakland Enquirer Pub. Co.		16 80
1,000 booklets, "Art in Education"—Oakland Enquirer Pub. Co.		14 00
1 quire drawing paper—H. S. Crocker Co.		3 00
1 roll 26″ tracing-paper—H. S. Crocker Co.		2 00
1 gross stub pens—H. S. Crocker Co.		35
1 lb. C. yellow—Bass-Hueter Paint Co.		30
1 lb. C. blue—Bass-Hueter Paint Co.		40
1 lb. flake white—Bass-Hueter Paint Co.		50
1 bot. glue—Bass-Hueter Paint Co.		15
2 brushes—Bass-Hueter Paint Co.		70
1 bot. turkey red, in water—Bass-Hueter Paint Co.		40
1 bot. Vandyke brown—Bass-Hueter Paint Co.		15
Gum arabic—Bass-Hueter Paint Co.		05
1 doz. pine easels—Sanborn, Vail & Co.		4 80
1 pr. shears—Sanborn, Vail & Co.		1 00
2 brushes—Sanborn, Vail & Co.		1 00
		$299 89

APPENDIX NO. 29—*Department of Philosophy.*

Marine insurance—Balfour, Guthrie & Co.	$0 97
Brokerage—C. D. Bunker & Co.	4 00
	$4 97

APPENDIX NO. 30—*Johnson Building.*

Abstract of title, lot on Sutter Street—Joseph and E. B. Clement	$175 00
Water	42 92
Gas	33 61
Coal	126 90
Electric light	5 66
Garbage	4 25
Gas regulator	1 70
Telephone	1 42
Plumbing	7 75
Taxes	442 68
Rental of 3 auxiliary boxes, from December 18, 1895—Pacific Auxiliary Fire Alarm Co.	36 00
Requisition books—Hicks-Judd Co.	7 50
Recording deed—Thos. J. Glynn.	3 50
Binding 4 books (receipts)—Hicks-Judd Co.	2 00
Rental of telephone—Pacific Tel. & Tel. Co.	2 50
Sawdust—John Kusel	50
1 duster—Joseph Figer	1 25
2 brooms—Joseph Figer	90
Removing garbage—S. F. Street-Sweeping and Garbage-Removing Co.	7 50
11 lbs. ⅛ Badger packing—Goodyear Rubber Co.	2 75
Rent of regulators—Universal Gas Saving Ass'n	3 00
Numbering letter boxes—H. H. Miller	50
6 electric lamps—J. W. Brooks & Co.	1 50
Repairing boiler—Ed. Wolfe	1 50
Repairing boiler—Ed. Wolfe	1 50
Plumbing—E. James Duffey	2 00
Electric light—Edison Light and Power Co.	21 75
Plumbing—Richard Rice	19 00
Water—Spring Valley Water Works	77 75
Painting and whitening—C. M. Waller	11 00
37 tons coal—Black Diamond Coal Mining Co.	214 00
Screenings (3 tons)—John Middleton	13 26
Gas—Pacific Gas Improvement Co.	91 70
10 gals. cylinder oil—A. C. Dietz & Co.	9 00
5 gals. Prize Medal oil—A. C. Dietz	1 25
Firebrick and clay, relining boilers—Henry Cowell & Co.	4 50
Repairing safety valve—W. T. Garratt & Co.	3 65
Carpenter work—W. Paulson	3 60
1 stamp and pad—L. H. Moise	2 25
Electric lights—Edison Light and Power Co.	24 65
Rent of telephone—Pacific Tel. & Tel. Co.	2 50
Sawdust and ammonia—John Kusel	70
Sponge—J. Figer	65
1 broom—J. Figer	40
1 dustpan—J. Figer	20
6 mops—J. Figer	1 25
1 pail—J. Figer	30
Removal of garbage—S. F. Street-Sweeping and Garbage-Removing Co.	7 50
Cartage—J. E. Layton	1 65
1½ lbs. packing—Revere Rubber Co.	35
2 gauge glasses and washers—J. Caire Co.	65
Repairing boiler—E. Wolfe	1 50
Numbering letter boxes—H. H. Miller	85
Carpentering—A. Hayman	1 80
Water—Spring Valley Water Works	72 85
½ barrel boiler compound—J. C. West	19 40
Plumbing—Duffey Bros	19 50
1 ton screenings—John Middleton	4 47
repairing sidewalk—H. Schottler	8 00
Gas regulator—Gas Consumers' Ass'n	3 00
Gas, January to December—Pacific Gas Improvement Co.	94 15
36 tons coal—Black Diamond Coal Mining Co.	206 50
Rent of telephone—Pacific Tel. & Tel. Co.	2 50
Removal of Garbage—S. F. Street-Sweeping and Garbage-Removing Co.	7 50
12 duster—Joseph Figer	2 00
brooms—Joseph Figer	80
1 mop handle—Joseph Figer	20
Sawdust and soap—John Kusel	75

Johnson Building—Continued.

Numbering letter boxes	$1 00
1 pane glass—M. Lewis	65
Whitening and painting—C. M. Walker	12 00
2 tons screenings—John Middleton	8 29
Water, January to February—Spring Valley Water Works	68 60
Gas, January to February—Pacific Gas Improvement Co.	64 40
36 tons coal—Black Diamond Coal Mining Co.	209 25
Gas regulator—Gas Consumers' Ass'n	3 00
1 rubber stamp—C. A. Klinker & Co.	25
Gas, February to March	51 45
8 tons Wellington screenings—R. D. Chandler	36 00
Repairing plaster work, etc.—C. M. Walker	40 50
Rubber valves—W. T. Garratt & Co.	10 65
10 gals. cylinder oil—A. C. Dietz & Co.	9 00
Candles—A. C. Dietz & Co.	1 00
30 tons and 1,580 lbs. Green River coal—Black Diamond Coal Mining Co.	171 95
Gas regulator—Gas Consumers' Ass'n	3 00
Binding 4 receipt books—Hicks-Judd Co.	2 00
Rent of telephone—Pacific Tel. & Tel. Co.	2 50
Removal of garbage—S. F. Street-Sweeping and Garbage-Removing Co.	7 50
2 wool sponges—Buchanan Bros.	1 50
1 spittoon—Buchanan Bros.	75
1 brush—Buchanan Bros.	75
3 cakes sapolio—Buchanan Bros.	25
Sawdust—John Kusel	50
¾" cup leathers—A. J. McNicoll & Co.	1 20
⅞ lb. P. P. P. packing—Briggs, Goodrich & Co.	80
1 No. 3 scoop—Miller, Sloss & Scott	85
1 doz. Edison lamps—Edison Light and Power Co.	2 40
1 walnut push-button—Will & Finck Co.	75
Carpentering—W. Paulson	1 75
Carpentering—W. Paulson	5 00
Postage stamps—B. Bangs	50
Water, February to March—Spring Valley Water Works	64 50
1 hydraulic ram freight elevator—Cahill & Hall Elevator Co.	350 00
Light—Edison Light and Power Co.	6 50
Carpentering—W. Paulson	42 00
1 case toilet paper—Jos. A. Hofmann	6 00
Rental of telephone—Pacific Tel. & Tel. Co.	2 50
Removal of garbage—S. F. Street-Sweeping and Garbage-Removing Co.	7 50
2 brooms—Joseph Figer	80
1 dustpan—Joseph Figer	20
6 mops—Joseph Figer	1 25
Sawdust—John Kusel	50
Locks, keys, etc.—A. Heymann	2 65
Rechanging batteries and repairing bells—Will & Finck Co.	2 05
3 new carbons—Will & Finck Co.	1 50
3 new zincs—Will & Finck Co.	30
1 La Clede battery—Will & Finck Co.	75
Numbering letter boxes—H. H. Miller	50
2 shades—Indiana Auction Co.	1 40
Water, March to April—Spring Valley Water Works	69 20
2 elevators insured—London Guarantee and Accident Co.	50
Whitening and cleaning two rooms—C. M. Walker	15 00
Repairs to watertank—Schuster Bros.	9 00
1 case toilet paper—Jos. A. Hofmann	6 00
Gas regulator—Gas Consumers' Ass'n	3 00
Electric light—Edison Light and Power Co.	2 60
33 tons and 1,320 lbs. Wellington screenings—R. D. Chandler	151 15
9 tons and 1,670 lbs. Green River coal—Black Diamond Coal Mining Co.	54 60
Putting in doors—W. Paulson	11 00
Gas, March to April—Pacific Gas Improvement Co.	38 50
Gas, April to May—Pacific Gas Improvement Co.	33 60
40 tons and 1,500 lbs. Wellington screenings—R. D. Chandler	183 00
Water, April to May—Spring Valley Water Works	54 90
Changes in rooms 10, 11, 12, and 13—A. McIver	14 00
Alterations in room 37—R. J. Pavert	23 00
Painting, whitening, and repairing 4 rooms—Jas. C. Sellers	55 00
Gas regulator—Gas Consumers' Ass'n	3 00
Painting doors and frosting glass—Jas. C. Sellers	7 50
Repairing smokestack—F. Zibb	11 00
5 gals. machine oil—A. C. Dietz & Co.	3 25
5 gals. Valvate cylinder oil—A. C. Dietz & Co.	4 50
Telephone—Pacific Tel. & Tel. Co.	2 50
Removing garbage—S. F. Street-Sweeping and Garbage-Removing Co.	7 50

Johnson Building—Continued.

Sawdust—J. Kusel	$0 50
Sapolio—J. Kusel	25
1 sponge—Buchanan Bros.	1 50
1 galv. iron bucket—Buchanan Bros.	75
1 mop handle—Buchanan Bros.	35
2 lbs. packing—Briggs, Goodrich & Co.	2 00
Carpentering—W. Paulson	5 00
Taking down fixtures in room 12—R. Rice	1 25
Repairing leader pipe—R. Rice	3 75
Repairing faucet—R. Rice	1 00
Putting in 1 3″ box bell—Will & Finck Co.	1 85
1 extra-wide shade—Indiana Auction Co.	1 45
Postage stamps	1 00
10 pieces pine—M. Lambeth Co.	1 95
Electric light, February to March, 1896—Edison Electric Light and Power Co.	11 35
Repairs to boiler—P. F. Dundon's S. F. Iron Works	37 85
1 keyed socket—Edison Light and Power Co.	15
Salaries for the year ending June 30, 1896	2,393 54
	$6,402 75

APPENDIX NO. 31—*Propagating House.*

Excavating—Joe McKeown		$6 00
Excavating—Wm. Walters		18 00
Excavating—Neal Kelley		38 00
1 gal. paint—S. Wakeham		1 75
20 pieces redwood, 1″x 24″x 12′—Henry W. Taylor		12 00
100 4″ drain tile—Gladden, McBean & Co.		4 00
180 ft. surfaced redwood—Pacific Lumber Co.	$4 50	
1 keg 10d wire nails—Pacific Lumber Co.	2 40	
	6 90	
Less 2%	14	
		6 76
624 ft. Oregon pine, S. 1 S.; 234 ft. Oregon pine, S. 1 S.; 80 ft. redwood—Pacific Lumber Co.		12 75
Labor		151 20
Services of architect—Clinton Day		408 28
76 lbs. galv. iron—J. J. Menges		4 00
Rivets—J. J. Menges		15
Labor—J. J. Menges		6 00
Constructing brick annex—Whitney & Mara		1,400 00
Labor		81 00
Labor		28 00
1 galv. steel sink—A. Erlandsen		3 00
1 pr. galv. brackets—A. Erlandsen		1 35
1 2″ galv. elbow—A. Erlandsen		35
20 ¾″ galv. elbows—A. Erlandsen		1 60
6 ¾″ tees—A. Erlandsen		60
3 ¾″ crosses—A. Erlandsen		35
2 ¾″ ells and bushings—A. Erlandsen		25
1 2″ nipple—A. Erlandsen		10
1 key fitted—A. Erlandsen		25
5 ¾″ galv. tees—A. Erlandsen		50
6 ¾″ caps—A. Erlandsen		25
6 ¾″ ells and bushings—A. Erlandsen		75
29½ lbs. sheet lead—A. Erlandsen		2 45
6 ells and bushings—A. Erlandsen		75
1 stopcock—A. Erlandsen		60
2 bushings—A. Erlandsen		10
1 hinge—A. Erlandsen		10
2 lengths stovepipe—A. Erlandsen		50
1 collar for stovepipe—A. Erlandsen		10
Labor		92 00
6 garden valves—A. Erlandsen		5 00
1 length 1″ pipe—Wm. Bullerman		1 70
3 1¼″ pipe couplings—Wm. Bullerman		45
1 reducer, 1¼″—Wm. Bullerman		15
4 galv. iron elbows—Wm. Bullerman		40
1 galv. tank—J. J. Menges		18 50
10 No. 1 vapor pans—J. Menges		45 00
		$2,355 04

APPENDIX No. 32—*C. F. Crocker Donation for Eclipse Expedition.*

Telegrams—Western Union Tel. Co.		$2 14
1 doz. 18x20 Crown plates—G. Cramer Dry Plate Works		13 18
Freight—Southern Pacific Co.		26
Freight—Atlantic & Pacific R. R. Co.		4 20
241 ft. ½″ pipe—Farmers' Union		7 23
20 ½″ tees—Farmers' Union		1 00
Expressage—Wells, Fargo & Co.		7 75
Telegram—Western Union Tel. Co.		1 00
Hauling—J. Wandell		1 98
1½ set casters—Dunham, Carrigan & Hayden Co.		45
1 bdl. iron—Dunham, Carrigan & Hayden Co.		1 69
72 threaded nuts—Dunham, Carrigan & Hayden Co.		30
200 washers—Dunham, Carrigan & Hayden Co.		20
1 8-oz. bro duck tube—Neville & Co.		24 25
1 tent, 6x7—Neville & Co.		5 75
Drayage—Neville & Co.		25
1 6″ photo objective—John A. Brashear		325 00
2 doz. 5x7 Seed's plates—Hirsch & Kahn		1 98
1 6x4 American flag—Neville & Co.		3 75
Bill of Hirsch & Kahn:		
1 doz. 20x24 solio paper	$3 00	
3 doz. 8x10 Carbutt A plates	7 20	
20 ozs. hydrochinon	8 00	
100 ozs. sulphite soda	1 50	
20 ozs. caustic potash	1 15	
	$20 85	
Less 10%	2 08	18 77
Bill of M. A. Seed Dry Plate Co.:		
2 doz. 18x22 plates	$38 80	
4 doz. 8x11 plates	12 00	
6 doz. 5x7 plates	8 40	
	$59 20	
Less 20%	11 84	47 36
Bill of J. Carbutt:		
2 doz. 8x10 Ed. Col. plates	$5 80	
2 doz. 5x7 Ed. Col. plates	2 60	
	$8 40	
Less 15%	1 26	7 14
Estimated expenses to be incurred on a trip to observe the solar eclipse in Japan—J. M. Schaeberle		1,150 00
Telegram—Western Union Tel. Co.		35
Expressage—Wells, Fargo & Co.		6 10
Hauling freight—F. H. Ross & Sons		1 75
1 doz. boxes—A. Fleishhacker & Co.		1 50
50 yds. silesia—A. H. Marten		4 25
Bill of G. Cramer Dry Plate Works:		
1⅓ doz. 10x12 Crown plates	$12 65	
1 doz. 5x8 Crown plates	1 25	
1 doz. 5x8 Crown plates	1 25	
⅔ doz. 10x12 Crown plates	5 05	
	20 20	
Less 20%	4 04	16 16
Boxes		1 80
Expressage—Wells, Fargo & Co.		8 05
Expressage—Wells, Fargo & Co.		4 15
Hauling—F. H. Ross & Sons		98
6 doz. Seed's plates—Hirsch & Kahn		5 94
Hauling—J. Wandell		5 87
		$1,682 53

APPENDIX No. 33—*A. Blair Thaw Donation.*

Fitting new shutter to L. O. sun-shutter—General Electric Co.	$100 00

APPENDIX No. 34—*Phebe Hearst Donation.*

1 doz. dry plates—M. A. Seed Dry Plate Co.	$5 00
Expressage—Wells, Fargo & Co.	3 50
Experimental clock movement—F. H. McConnell	10 00

Phebe Hearst Donation—Continued.

Plateholder and base—Chas. Burchhalter	$8 00
1 sheet aluminum—Chas. Burchhalter	65
Cross-section paper—Chas. Burchhalter	60
2 doz. 5x7 plates—Chas. Burchhalter	2 20
6 plate holders—S. Slayton	30 00
Ground glass—Henry Kahn & Co.	35
2 agateware pans—Henry Kahn & Co.	1 80
2 doz. 10x12 plates—Henry Kahn & Co.	7 60
2 doz. 5x7 plates—Henry Kahn & Co.	2 20
Developer—Henry Kahn & Co.	2 25
1 doz. 5x7 plates—Henry Kahn & Co.	1 25
1 lb. ox. potash—Henry Kahn & Co.	25
1 oz. potass. bromide—Henry Kahn & Co.	15
Part payment for making 6 driving-clocks—F. H. McConnell	24 20
	$100 00

APPENDIX NO. 35 A—*Fund for Installing the Crossley Reflector—Year 1894-95.*

	£	s.	d.	
Taking down the dome—Edward Crossley	30	0	0	
Insurance to New York—Edward Crossley	9	6	11	
Railway charges to Liverpool—Edward Crossley	17	18	9	
Freight, Liverpool to New York—Edward Crossley	41	6	10	
Sundries, taking down instruments, etc.—Edward Crossley	35	11	11	
New roof—Edward Crossley	65	15	7	
	£200	0	0	$980 00
Traveling expenses—E. S. Holden				28 50
1,000 ft. 1x12x12 M. ch. S. 2 S.—Glenwood Lumber Co.				17 00
200 ft. galv. pipe—Holbrook, Merrill & Stetson				65 55
1,500 ft. 1¼x4 T. & G. pine—Wilson Bros. & Co.				32 25
2,501 ft. No. 1 pine—Wilson Bros. & Co.				30 01
90 bbls. Gillingham Portland cement—J. D. Spreckels & Bros. Co.				202 50
18 mounted Alb. prints—Taber Photographic Co.				9 00
1 10-lb. sledge and handle—Boschken Hardware Co.				10 10
6 sticks giant powder—Farmers' Union				40
Soft fuse—Farmers' Union				25
1 box caps—Farmers' Union				40
2 sacks charcoal—Farmers' Union				1 50
6 sledge handles—Farmers' Union				1 13
3 shovels—Farmers' Union				3 75
½ lb. point steel—Farmers' Union				1 05
20 bbls. lime—Farmers' Union				35 00
20 bbls. lime—Farmers' Union				35 00
500 ft. 1½″ galv. pipe—Holbrook, Merrill & Stetson				46 87
400 lbs. white lead—American Oil Co.				22 00
Freight—American Oil Co.				37
302¼ ft. 1½″ galv. pipe—John Stock Sons				36 27
302⅔ ft. 1″ galv. pipe—John Stock Sons				21 57
36 pieces 3″ dipped casing—Dunham, Carrigan & Hayden Co.				68 85
Cartage—Dunham, Carrigan & Hayden Co.				1 25
Freight—Dunham, Carrigan & Hayden Co.				1 39
Hauling—L. Bernal				143 74
Delivering 118 sacks sand—J. R. Kincaid				23 20
Labor, preparing site, etc.				127 60
Hauling—L. Bernal				62 51
Hauling—J. Wandell				9 46
236 sacks sand—J. R. Kincaid				50 68
Hauling—J. R. Kincaid				19 68
1,272 ft. T. & G. redwood—Union Lumber Co.				22 26
Cartage—Union Lumber Co.				64
150 ft. 2x3x12 redwood—Glenwood Lumber Co.				2 25
8 rolls tin—Glenwood Lumber Co.				30 24
Labor, preparing site, etc.				111 22
Hauling—J. R. Kincaid				19 46
Hauling—J. Wandell				10 18
Freight—Southern Pacific Co.				42 78
Labor, preparing site, making roads, etc.				163 50
Hauling—J. Wandell				17 20
				$2,508 56

APPENDIX NO. 35 B—*Fund for Installing the Crossley Reflector, Year 1895-96.*

1 keg 8d nails—Farmers' Union	$2 80
10 kegs 10d nails—Farmers' Union	2 75
2 2½″ nipples—John Stock Sons	75
2 2½″ ells—John Stock Sons	80

Fund for Installing the Crossley Reflector—Continued.

3½ ft. 1" galv. pipe—John Stock Sons	$3 12
7½ ft. 1½" galv. pipe, threads, etc.—John Stock Sons	1 97
Unloading 75 bbls. cement—Southern Pacific Co.	3 00
Hauling—J. Wandell	4 24
Telegrams—Western Union Tel. Co	1 26
Hauling—J. Wandell	7 20
700 sacks sand—Markovits Bros.	17 50
Hauling freight—L. Bernal	56
1 keg 40d nails—Farmers' Union	2 20
½ keg blasting powder—Farmers' Union	1 25
50 ft. fuse—Farmers' Union	50
3 sticks giant powder—Farmers' Union	25
25 rings—John Stock Sons	50
Hauling freight—J. Wandell	6 00
50 ft. ½" oak molding—J. Wandell	2 00
Freight—Southern Pacific Co.	25
Hauling—J. Wandell	5 76
2 days' labor—C. C. Chesterman	4 00
Freight—Southern Pacific Co.	25
Hauling—L. Bernal	2 82
200 ft. 2x4x12 common redwood—Glenwood Lumber Co.	3 00
1,000 ft. T. & G. redwood—Glenwood Lumber Co.	20 00
72 ft. C., S 4 S.—Glenwood Lumber Co.	1 80
128 ft. 2x12x16 Oregon pine—Glenwood Lumber Co.	1 92
192 ft. redwood 2x4x16 and 4x4x16—Glenwood Lumber Co.	2 88
30 ft. T. & G. Oregon pine—Glenwood Lumber Co.	90
24 ft. Oregon pine steps 1x12x16—Glenwood Lumber Co.	96
112 ft. Oregon pine, 2x4x6—Glenwood Lumber Co.	5 04
85 ft. Oregon pine, 2x6x6, nosed—Glenwood Lumber Co.	3 82
55 ft. clear, 1x8x6—Glenwood Lumber Co.	1 40
13 pieces ¾ scotia, and 80 ft. 1x1 quarter round—Glenwood Lumber Co.	69
800 ft. 2x10 cap—Glenwood Lumber Co.	3 10
24 1½" lock nuts—John Stock Sons	1 44
8 1½" gate valves, 14 ft. ½" pipe—John Stock Sons	17 09
Labor—John Stock Sons	7 20
1 hoop set and handle—Farmers' Union	85
6 bbls. lime—Farmers' Union	10 50
4 bbls. lime—Farmers' Union	7 00
Labor on Crossley dome	156 00
Hauling—J. Wandell	9 88
Hauling—L. Bernal	32 00
Labor building Crossley dome	342 80
Patent non-shrinking tank—W. E. Hampton	215 00
3,123 ft. Oregon pine—W. E. Hampton	37 50
128 ft. redwood—W. E. Hampton	2 05
Millwork—W. E. Hampton	2 00
Cartage on lumber—W. E. Hampton	3 00
Prepaid freight on lumber—W. E. Hampton	10 00
Prepaid freight on tanks—W. E. Hampton	10 80
Labor—F. G. Radelfinger	9 33
Hauling—L. Bernal	30 04
Hauling—Mrs. B. Bernal	12 00
Labor, preparing site for dome	89 75
Hauling—L. Bernal	44 02
Labor on Crossley dome	156 00
Hauling—J. Wandell	4 80
Hauling—J. Wandell	4 80
9 window frames, glazed, and 1 outside door frame and sash door, 5 interior doors, frames, etc.—Miller & Hamilton	100 00
1 panel door—Miller & Hamilton	14 00
500 ft. 2x6 Oregon pine—Miller & Hamilton	6 00
600 ft. 1x6 Oregon pine flooring—Miller & Hamilton	10 20
1 center for brick arch—Miller & Hamilton	3 50
Cartage—Miller & Hamilton	1 00
20 rough brackets—Miller & Hamilton	2 50
Freight—Miller & Hamilton	4 10
Painting outside frames and sash, varnishing interior door frames, etc.—Miller & Hamilton	12 00
Labor on Crossley dome	39 00
Delivering sand, 112 sacks—J. R. Kincaid	20 48
Delivering 39 sacks gravel—J. R. Kincaid	8 08
Labor on Crossley dome	56 75
48 ft. 2½ galv. iron leader—Forderer Cornice Works	4 80
½ doz. leader hooks—Forderer Cornice Works	1 20
Freight—Forderer Cornice Works	75

Fund for Installing the Crossley Reflector—Continued.

	Galv. iron gutter, etc.—Forderer Cornice Works	$140 00
50	sheets tin—Glenwood Lumber Co.	3 25
1,620	ft. Oregon pine—Glenwood Lumber Co.	24 30
350	ft. redwood, S 2 S.—Glenwood Lumber Co.	5 95
	Labor—Keatinge, Leonard & Ransome	4 00
	Millwork—Keatinge, Leonard & Ransome	14 25
	Twisted iron, 870 lbs.—Keatinge, Leonard & Ransome	30 45
	Iron work, bolts, etc.—Keatinge, Leonard & Ransome	3 00
800	dog anchors—Golden West Iron Works	6 61
12	hours' labor—Golden West Iron Works	3 60
10	shutter eyes—Golden West Iron Works	2 00
1	angle iron track—Golden West Iron Works	1 26
20	cast ventilators—Golden West Iron Works	9 24
	Painting ventilators—Golden West Iron Works	25
	Cartage—Golden West Iron Works	25
	Band iron and tee lintel—Golden West Iron Works	3 68
4	flat lintels—Golden West Iron Works	2 49
2	prs. No. 3 door hangers—Golden West Iron Works	1 50
1	set C. D. locks—Golden West Iron Works	2 50
2	strips brass, 26 lbs.—Golden West Iron Works	6 50
6	doz. brass screws—Golden West Iron Works	1 10
10	sheets galv. iron—Golden West Iron Works	4 73
	Labor—Golden West Iron Works	7 00
10	lbs. galv. nails—Golden West Iron Works	1 20
2	packing cases—Golden West Iron Works	50
	Cartage to depot—Golden West Iron Works	50
	Labor on Crossley dome	72 00
2¾	lbs. washers—Farmers' Union	17
1	strip copper, 12 ft.—Mangrum & Otter	3 50
320	ft. Oregon pine—Glenwood Lumber Co.	4 80
1	qt. muriatic acid—Farmers' Union	40
6	sacks charcoal—Farmers' Union	2 70
	Hauling freight—J. Wandell	4 82
	Freight—Southern Pacific Co.	30
5	bbls. lime—Farmers' Union	8 75
4	spools annunciator wire—John A. Roebling's Sons Co.	6 90
	Labor on Crossley dome—F. G. Radelfinger	2 00
	Sliding tube—General Electric Co.	27 50
	Insurance on 5 cases containing telescopes—B. Westermann & Co.	50 00
	Entry charges on same	10 00
	Labor—F. Gardiser	16 50
	Hauling—F. H. Ross & Sons	24 00
	Hauling gravel and sand—J. R. Kincaid	12 04
	Labor, making artificial stone cap—J. H. Riechers	50 00
	Labor on dome	77 50
	Hauling—J. Wandell	4 08
2	wash basins—W. W. Montague & Co.	8 10
	Board for tinman—W. N. Jess	7 25
	Stage fare—F. H. Ross	3 00
	Telegrams—Southern Pacific Co.	76
	Custom-house charges—Southern Pacific Co.	1 20
	Transfer in New York—Southern Pacific Co.	9 44
	Expenses of transferring the dome for Crossley reflector, drayage—Southern Pacific Co.	21 00
	Telegrams to Treasury Dept.—Southern Pacific Co.	47
	Custom-house charges in N. Y. City—Southern Pacific Co.	1 20
	Custom-house charges in N. Y. City—Southern Pacific Co.	1 20
	Drayage in New York—Southern Pacific Co.	5 98
8	days 2 hours, tinner—Mangrum & Otter	32 90
2	gals. gasoline—Mangrum & Otter	50
45	sheets 14x20 tin—Mangrum & Otter	4 05
	Dinner at Smith's Creek—Mangrum & Otter	50
	Labor on Crossley dome	12 38
2	pieces spring brass—C. F. Marwedel	25
5	pieces plain brass, $\frac{1}{43}$, $\frac{1}{32}$—C. F. Marwedel	1 10
1	tap drill—C. F. Marwedel	10
6	shoulder-milled screws—C. F. Marwedel	38
2	plain-milled screws—C. F. Marwedel	16
⅔	doz. milled thumb nuts—C. F. Marwedel	40
½	doz. shoulder-milled screws, 8x½—C. F. Marwedel	51
3	ft. Stub's steel, ⅛x⅜—C. F. Marwedel	45
1	ft. round steel—C. F. Marwedel	30
1	brass plate, 3x12x⅛—C. F. Marwedel	60
	Planing same—C. F. Marwedel	1 00
1	doz. assorted jeweler's saws—C. F. Marwedel	25
1	Scotch stone—C. F. Marwedel	35

Fund for Installing the Crossley Reflector—Continued.

33 lbs. rivets—Farmers' Union	$2 48
Expressage—Wells, Fargo & Co.	1 45
Work in building spectroscope—Percival Urmy	32 00
4 whitewash brushes—Farmers' Union	40
3 gals. alcohol—Brassy & Co.	9 00
2 doz. saws—Nordman Bros.	20
3 sheets emery—Nordman Bros.	10
Postage—Nordman Bros.	09
Work on spectroscope—Percival Urmy	60 00
	$2,487 90

Appendix No. 36—*Donation for Lighting University Library.*

Labor, 16 days—W. H. Lozier	$38 40
1 36-light electric fixture—S. F. Novelty & Plating Works	65 00
2 24-light electric fixtures—S. F. Novelty & Plating Works	100 00
4 4-light electric fixtures—S. F. Novelty & Plating Works	32 00
100 opalescent shades—S. F. Novelty & Plating Works	28 80
160 wall sockets, 300 key sockets, 250 2¼″ shade holders	9 20
Expressage—Patterson & Co.	1 00
Wiring library—R. W. Lohmann & Co.	221 00
4,000 ft. No. 12 double-braid weather-proof wire—Washburn-Moen Mfg. Co.	19 43
1,000 ft. No. 12 R. C. wire—Washburn-Moen Mfg. Co.	15 60
1,000 ft. No. 14 R. C. wire—Wasburn-Moen Mfg. Co.	11 60
1,000 ft. No. 8 R. C. wire—Washburn-Moen Mfg. Co.	24 00
300 key sockets—General Electric Co.	48 00
250 shade holders—General Electric Co.	8 00
160 keyless receptacles—General Electric Co.	24 00
10 doz. 8″ opal shades—General Electric Co.	18 75
500 bushings—General Electric Co.	2 50
600 16-C.P. lamps—General Electric Co.	120 00
Labor, 39 hours—General Electric Co.	11 70
685 lbs. ⅜ W. P. wire—Berkeley Electric Lighting Co.	106 00
64 D. G. insulators—Berkeley Electric Lighting Co.	3 52
64 iron pins—Berkeley Electric Lighting Co.	6 40
16 cross arms—Berkeley Electric Lighting Co.	5 00
32 lag screws—Berkeley Electric Lighting Co.	1 60
Labor—Berkeley Electric Lighting Co.	1 50
1 pole—Berkeley Electric Lighting Co.	6 00
1 comfort—Taft & Pennoyer	4 00
1 pr. blankets—Taft & Pennoyer	5 25
110 meals—University Dining Ass'n	27 50
	$965 75

Appendix No. 37—*Donation for Lighting University Grounds.*

16 days' labor—W. H. Lozier	$38 40
25 lamp hoods—Thos. Day & Co.	25 00
Expressage—Patterson & Co.	6 25
5 gals. stock paint—Paraffine Paint Co.	3 00
18 clear globes, 4x12″—General Electric Co.	13 50
18 clear globes, 5x12″—General Electric Co.	13 50
12 opal globes, 4½x12—General Electric Co.	9 00
50 iron pins—General Electric Co.	5 00
1,000 ½x12 plain carbon—General Electric Co.	10 50
3 lbs. tape—General Electric Co.	1 50
500 porcelain insulators—General Electric Co.	3 00
39 hours' labor—W. H. Lozier	11 70
1 50-lt. arc dynamo and 25 2,000-C.P. arc lamps—General Electric Co.	175 00
1 double bedstead, 1 spring mattress, 1 hair mattress—Schreiber Furniture Co.	22 50
1 washstand—Schreiber Furniture Co.	5 00
1 pr. feather pillows—Schreiber Furniture Co.	4 50
10 tons Walls End coal—J. C. Wilson & Co.	74 00
Expressage—Patterson & Co.	15 00
8 tons Wellington coal—Jas. P. Taylor	69 52
Construction of arc circuit—R. W. Lohmann & Co.	465 85
Clerical work—P. W. Willis	3 25
5 gross brass screws, assorted—Pierce Hardware Co.	4 36
1 lb. zinc—Pierce Hardware Co.	15
267 lbs. iron—Pierce Hardware Co.	6 67
100 lbs. staples—Pierce Hardware Co.	45
Sheet iron—Pierce Hardware Co.	75
100 stove bolts—Pierce Hardware Co.	75
5 lbs. zinc—Pierce Hardware Co.	75
	$988 85

STATE APPROPRIATION (ONE CENT FUND) FOR THE FISCAL YEAR ENDING JUNE 30, 1896.

The following is a statement of expenditures and receipts of the State University Fund as directed in an Act of the Legislature of the State of California entitled "An Act to provide for the permanent support and improvement of the University of California, by the levy of a rate of taxation, and the creation of a fund therefor," approved February 14, 1887:

RECEIPTS.

1895—Aug. 31—By cash on Controller's warrant	$2,029 61
Oct. 31—By cash on Controller's warrant	15 00
1896—Feb. 29—By cash on Controller's warrant	75,534 32
June 30—By cash on Controller's warrant	34,964 63
	$112,543 56

EXPENDITURES.

Department of Lick Observatory.

6 half-tone engravings—Union Photo-Engraving Co.	$35 40
1 glass reticle—Fauth & Co.	7 50
1 glass reticle—G. N. Sargmuller	7 50
2 reams paper—H. S. Crocker Co.	2 50
Expressage—Wells, Fargo & Co.	5 50
Money order—Postmaster, San José	1 56
Hauling freight—F. P. Childs	4 83
Freight—Southern Pacific Co.	75
Hauling freight—J. Wandell	3 92
Telegrams—Western Union Tel. Co.	1 91
Hauling—J. Wandell	8 60
Freight—Southern Pacific Co.	2 37
Hauling—J. Wandell	6 32
Hauling—J. Wandell	7 79
Telegram—Western Union Tel. Co.	27
Hauling—J. Wandell	6 43
Hauling—J. Wandell	3 60
1 6″ Willard lens—A. H. Reed	85 00
Express charges, etc.—A. H. Reed	6 80
1 horse blanket—E. S. Holden	3 50
Saddle cloth—E. S. Holden	1 50
Halter and strap—E. S. Holden	2 00
Neck collar and strap—E. S. Holden	1 25
Bridle—E. S. Holden	3 75
Lap robe—E. S. Holden	1 50
Postage stamps—A. L. Colton, P. M.	100 00
4 cords wood—J. Wandell	18 00
Telegrams—Western Union Tel. Co.	97
Expressage—Wells, Fargo & Co.	7 55
Hauling freight—F. P. Childs	7 89
Washing towels—Mrs. Sullivan	3 70
Expressage—Wells, Fargo & Co.	11 70
Hauling freight—F. P. Childs	3 37
3 electros—A. A. Beal & Co.	2 94
Telephone—Sunset Tel. & Tel. Co.	1 50
Telegrams—Western Union Tel. Co.	25
Hauling—J. Wandell	2 16
Board of team—S. W. McCarley	1 00
Repairing wagon—S. W. McCarley	75
6 lbs. lead—John Stock Sons	60
3 sockets—John Stock Sons	40
1 stub and trap—John Stock Sons	1 00
1 socket—John Stock Sons	95

Department of Lick Observatory—Continued.

3 lbs. solder, and labor—John Stock Sons		$2 05
2 varnish brushes—Farmers' Union		50
1 gal. distilled water—Farmers' Union		30
1 gal. demijohn—Farmers' Union		40
36 boxes—A. Fleishhacker & Co.		1 00
1 light glass—John Stock Sons		1 15
2 lbs. lace leather—John Stock Sons		1 60
1 check valve—John Stock Sons		1 25
Gross seed—Farmers' Union		1 00
Ammonia—Farmers' Union		25
1 can axle-grease—Farmers' Union		10
4 spools annunciator wire—J. A. Roebling's Sons Co.		6 90
12 crowfoot zincs—Paul Seiler Electrical Works		3 36
24 crowfoot coppers—Paul Seiler Electrical Works		2 88
12 lbs. sal ammonia—Paul Seiler Electrical Works		1 60
6 battery jars—Paul Seiler Electrical Works		2 10
6 papers tacks—Farmers' Union		30
1 doz. lantern globes—Farmers' Union		90
Gasoline—Farmers' Union		10
1 scrapbook—E. H. Guppy & Son		1 00
3 papers tacks—Farmers' Union		15
1 doz. sheets flypaper—Farmers' Union		15
1 cord wood—J. Wandell		4 50
1 doz. sheets blotting paper—Bonestell & Co.		1 00
1 box fasteners—E. H. Guppy & Son		25
20 ft. flax packing—Dunham, Carrigan & Hayden Co.		3 10
4 lights glass—John Stock Sons		1 50
3 lead con.—John Stock Sons		3 00
Labor—John Stock Sons		95
1 doz. picture hooks—John Stock Sons		25
3 pieces stovepipe—Farmers' Union		85
Paper—Farmers' Union		2 09
½ gal. oil—Farmers' Union		65
Dressing—Farmers' Union		25
Twine—Farmers' Union		1 95
Bot. ammonia—Farmers' Union		25
Bill of Yates & Co.:		
700 lbs. white lead	$40 25	
1 bbl. raw linseed oil	32 00	
50 lbs. yellow ochre	75	
1 bbl. Prince's metalic	4 50	
10 gals. copal varnish	6 00	
10 gals. turpentine	4 80	
20 gals. boiled linseed oil	14 40	
300 gals. Starlight oil	66 00	
6 lbs. best O. yellow	1 08	
6 lbs. best green	84	
6 lbs. best red	78	
3 lbs. best Tuscan red	54	
3 sash tools	30	
2 putty knives	40	
10 gals. benzine	2 20	
	$174 84	
Less 2%	3 49	
		171 35
4.19 cords four-foot wood—J. Wandell		18 85
100 gals. dynamo lubricating oil—W. P. Fuller & Co.		30 00
5 doz. Carbutt 8x10 A plates—Hirsch & Kahn		10 80
5 doz. Carbutt 6½x8½ plates—Hirsch & Kahn		7 50
1 32-oz. graduate—Hirsch & Kahn		1 50
3 lbs. hydrochinon—Hirsch & Kahn		13 50
½ lb. citric acid—Hirsch & Kahn		50
7 tons hay—L. Bernal		105 00
8 shades—L. Lion & Sons Co.		7 20
1 tapestry rug—L. Lion & Sons Co.		24 00
1 tapestry rug—L. Lion & Sons Co.		13 45
1 mirror—L. Lion & Sons Co.		4 00
Bill of John Stock Sons:		
30 prs. assorted sizes, wrot. butts	$3 10	
18 prs. assorted sizes, brass butts	1 80	
25 lbs. No. 3 wire nails	1 00	
25 lbs. No. 2½ wire nails	1 00	
15 lbs. No. 2 wire nails	65	

Department of Lick Observatory—Continued.

Bill of John Stock Sons—Continued.		
1 keg 8d wire nails	$2 60	
1 keg 40d wire nails	2 25	
1 gross screw eyes, assorted	40	
1 gross screw hooks, assorted	40	
2 coils picture wire	25	
2 doz. each, 0, 1, 1½, 2 sandpaper	96	
1 doz. 1 each, assorted sizes	45	
150 sq. ft. wire screen	6 00	
		$20 86
100 cap 4to records—Brown & Power		16 60
100 ft. 1½" 3-ply Niagara hose, coupled, with nozzles—Crane Co.		22 00
Rental of telephone—Sunset Tel. & Tel. Co.		35 00
5 doz. 8x10 Carbutt process plates—Hirsch & Kahn		10 80
5 doz. 8x10 Seed's transparency plates—Hirsch & Kahn		10 80
10 doz. 6½x8½ transparency plates—Hirsch & Kahn		15 00
1 multum in parvo dev. lamp—Hirsch & Kahn		6 50
1,600 ft. C. D.—Glenwood Lumber Co.		40 00
300 ft. sugar pine—Glenwood Lumber Co.		30 00
800 ft. C. D.—Glenwood Lumber Co.		20 00
1,400 ft. common redwood—Glenwood Lumber Co.		21 00
Bill of G. H. Tay Co.:		
100 ft. 2½" pipe, dipped	$14 50	
150 ft. 2" pipe, dipped	15 00	
200 ft. 1½" pipe, dipped	14 00	
250 ft. 1" pipe, dipped	10 63	
300 ft. ¾" pipe, dipped	9 75	
2½" fittings: 6 elbows	96	
6 nipples	66	
2" fittings: 6 tees	60	
6 elbows	48	
1 doz. nipples	24	
1½" fittings: 6 tees	42	
1 doz. elbows	72	
1 doz. nipples	42	
¾" fittings: 3 doz. tees	90	
3 doz. elbows	81	
3 doz. nipples	63	
2 doz. unions	1 68	
1 doz. ¾" faucets	4 20	
1 doz. ¾" gate valves	7 92	
6 1" faucets	3 90	
6 1" gate valves	5 10	
3 1½" gate valves	4 95	
3 2" gate valves	7 20	
		105 67
20 doz. 8x10 Seed's plates, No. 27—Hirsch & Kahn		45 60
2 oil stoves—John Stock Sons		14 00
4 half tones—Union Photo-Engraving Co.		23 40
1 half tone—Union Photo-Engraving Co.		8 00
1 piece netting 14' 6"x 10' 9"—Neville & Co.		5 75
1 rubber cover 7x7—Neville & Co.		4 00
1 diary—Cambridgeport Diary Co.		4 00
1,000 billheads—Hicks-Judd Co.		4 00
Care of Regents' rooms—Mrs. Sullivan		2 50
Freight—Southern Pacific Co.		1 00
Hauling freight—J. Wandell		2 74
Telephone messages—Sunset Tel. & Tel. Co.		70
Repairing pumps—D. Wight		3 50
Hauling freight—J. Wandell		1 06
1 gal. distilled water—Farmers' Union		30
Repairing fireplace—F. Gardiser		2 75
Freight—Southern Pacific Co.		45
2 cords wood—J. Wandell		9 00
2,730 lbs. hay—L. Bernal		20 47
6 Globe indexes—Payot, Upham & Co.		3 30
1doz. Globe transfers—Payot, Upham & Co.		4 20
1,000 envelopes—Payot, Upham & Co.		6 50
4 lbs. sash cord—Farmers' Union		1 24
3½ yds. canvas—Farmers' Union		55
1 piece 12x12-24 Oregon pine—Glenwood Lumber Co.		1 45
10 lbs. rope—Neville & Co.		1 00
Expressage—Wells, Fargo & Co.		14 10
Freight—Southern Pacific Co.		4 48

Department of Lick Observatory—Continued.

Freight—Southern Pacific Co.		$0 82
Hauling—F. P. Childs		4 79
Hauling—J. Wandell		20 74
Hauling—J. Wandell		1 26
4 bunches laths—Glenwood Lumber Co.		2 00
1 light glass, 25x30—Farmers' Union		75
1 light glass, 11¾x13⅞—Farmers' Union		15
1 doz. Rochester chimneys—Farmers' Union		1 10
1 bot. ammonia—Farmers' Union		25
1 can axle-grease—Farmers' Union		10
Soap—Farmers' Union		30
Toilet paper—Farmers' Union		1 00
6 mops—Farmers' Union		1 25
2 cuts—Dempster Bros.		2 50
2 cords wood—J. Wandell		9 00
1 Nature—B. Westermann & Co.		15
6 blank books—Brown & Power		1 20
2 door checks—John Stock Sons		5 00
7.75 cords wood—J. Wandell		34 87
Hauling lumber—L. Bernal		34 34
Comptes Rendus, Vol. 118—B. Westermann & Co.		28
Telegrams—Western Union Tel. Co.		4 45
60 ft. packing flax—Dunham, Carrigan & Hayden Co.		4 50
3½ lbs. twine—Neville & Co.		1 00
4 yds. canvas—Farmers' Union		60
1 T. W. ribbon—Brown & Power		1 00
4 No. 12 casters—Dunham, Carrigan & Hayden Co.		4 00
1 Globe index—Payot, Upham & Co.		30
2.87 cords wood—J. Wandell		12 91
Expenses of U. S. Asst. Appraiser and Inspector of Customs to San José to examine telescope, etc.—C. D. Bunker & Co.		7 00
Bill of Hicks-Judd Co. for binding:		
6 8vos, cloth	$3 90	
2 4tos, cloth	1 80	
4 8vos, half W. G.	3 40	
1 4to, half W. G.	1 10	
13 8vos, half roan	8 45	
9 4tos, half roan	8 10	
1 small folio	1 55	
1 4to, half mor.	1 35	
	$29 65	
Less	10	
		29 55
5$\frac{12}{100}$ cords four-foot wood—J. Wandell		23 04
Freight—Southern Pacific Co.		76
Repairing telephone line—L. Bernal		1 00
Hauling freight—J. Wandell		2 98
Hauling freight—J. Wandell		10 58
10 lbs. Manilla rope—Neville & Co.		70
50 lbs. 3″ Manilla rope—Neville & Co.		4 50
1 tin sign—L. Lieber		2 50
1 ream paper, 24x36—Bonestell & Co.		3 80
1 gross screw eyes—Farmers' Union		50
1 gal. distilled water—Farmers' Union		30
6 assorted jig saws—Mangrum & Otter		60
6 Cramer brown plates, 11x14—Taber Photographic Co.		2 50
Money order—Postmaster, San José		1 40
Telephone message—Sunset Tel. & Tel. Co.		35
4 doz. paper boxes—A. Fleishhacker & Co.		5 00
1 light glass—California Art-Glass, Blending, and Cutting Works		1 50
Freight—Southern Pacific Co.		3 42
Hauling freight—J. Wandell		6 32
Freight—Southern Pacific Co.		25
Hauling freight—J. Wandell		64
2 paint brushes—Farmers' Union		2 70
Toilet soap—Farmers' Union		50
5 sacks barley—E. S. Holden		2 96
University of California Magazine		1 50
2 cords four-foot wood—J. Wandell		9 00
8 doz. 4x5 Seed's plates No. 27—Hirsch & Kahn		4 95
2 doz. 8x10 Seed's plates No. 27—Hirsch & Kahn		4 55
1 G. S. reader—Hirsch & Kahn		1 00
1 G. S. reader—Hirsch & Kahn		1 03
2 negative racks—Hirsch & Kahn		80

Department of Lick Observatory—Continued.

1 negative rack, 11x14 (shop-worn)—Hirsch & Kahn	$0 50
2 8x10 Blair feather weight holders—Hirsch & Kahn	3 70
Expense of Inspector and Appraiser—C. D. Bunker & Co.	7 00
Expressage—Southern Pacific Co.	25
Hauling freight—F. H. Ross & Sons	10
Expressage—Wells, Fargo & Co.	12 70
Telegrams—Western Union Tel. Co.	15 49
Hauling freight—F. P. Childs	7 23
Hauling freight—F. P. Childs	1 34
2 cords four-foot wood—J. Wandell	9 00
Hauling freight—L. Bernal	37 62
6 qts. Carter's ink—Brown & Power	3 00
6 bots. water-proof ink—Brown & Power	1 50
6 small bots. red ink—Brown & Power	50
1 gross assorted pens—Brown & Power	1 00
1 doz. assorted pyramids pins—Brown & Power	1 00
7 boxes fasteners—Brown & Power	1 25
2 doz. small penholders—Brown & Power	50
1 doz. Faber's blue pencils—Brown & Power	75
2 bots. mucilage—Brown & Power	1 00
Cleaning and adjusting clocks—F. H. McConnell	20 00
1 doz. 11x14 Seed's plates—Hirsch, Kahn & Co.	4 50
5 doz. 6½x8½ Carbutt's A plates—Hirsch, Kahn & Co.	7 50
6 Seed's plates, 11x14—Hirsch, Kahn & Co.	2 25
Hauling parts of Crossley dome—L. Bernal	188 13
50 gals. raw linseed oil—W. P. Fuller & Co.	22 50
6 11x14 Seed's plates—Taber Photographic Co.	2 50
100 ft. ½″ oak molding—D. Rinaldo	4 00
20 ft. 1″ oak molding—D. Rinaldo	1 00
1 doz. negative boxes—A. Fleishhacker & Co.	1 25
40 pieces 8x13 carbon paper—H. S. Crocker Co.	1 00
5 lbs. 24 B. C. twine—Farmers' Union	1 00
5 lbs. 18 B. C. twine—Farmers' Union	1 00
6 lamp shades—Farmers' Union	1 50
1 bottle ammonia—Farmers' Union	25
1 broom—Farmers' Union	60
1 invoice file—E. H. Guppy & Son	1 50
1 photo album—H. S. Crocker Co.	2 00
Hauling freight—J. Wandell	34
Telephone message—Sunset Tel. & Tel Co.	30
1 "Engineering," No. 1488—B. Westermann & Co.	15
1 "Knowledge," August, 1894—B. Westermann & Co.	15
1 24″ circular cut saw—Pacific Saw Mfg. Co.	12 00
10 doz. 8x10 Seed's plates, No. 27—Hirsch & Kahn	21 60
8 lbs. Mercks' C. P. carbonate of soda—Hirsch & Kahn	4 80
10 doz. Seed's transparency plates, 6½x8½—Hirsch & Kahn	15 00
2 doz. 8x10 Carbutt A plates—Hirsch & Kahn	4 30
4 doz. 11x14 Seed's plates, No. 27—Hirsch & Kahn	18 00
2 doz. 8x10 Carbutt A plates—Hirsch & Kahn	4 30
5 doz. 8x10 Seed's transparency plates—Hirsch & Kahn	10 80
2 doz. 6½x8½ Seed's transparency plates—Hirsch & Kahn	2 97
6 lights plain glass—Farmers' Union	12 00
4 lights glass, 10½″x4″—Farmers' Union	7 00
Delivering 9.86 cords wood—J. Wandell	44 37
Delivering 4 cords wood—J. Wandell	18 00
29 lbs. zinc—Mangrum & Otter	2 90
1 gross screw eyes, No. 114; ½ gross hooks and eyes, 3″; ½ gross hooks and eyes, 4″	2 00
34 lights glass, assorted sizes—W. P. Fuller & Co.	14 50
30 dozen 8x10 cross-ruled pads—Brown & Power	27 00
30 dozen 5x8 plain-ruled pads—Brown & Power	14 40
1 Astronom. Nachrichten, Vols. 139, 150—B. Westermann & Co.	8 00
1 tin, 16x20—Glenwood Lumber Co.	7 20
1 Dow steam plunger pump—Dow Steam Pump Works	290 00
1 circle with verniers, and graduated—The A. Leitz Co.	15 00
2 dozen 8x10 Seed's plates, No. 27—Hirsch & Kahn	4 32
8 dozen 6½x8½ Seed's transparency plates—Hirsch & Kahn	11 88
5 dozen 8x10 Eastman's transparency plates—Hirsch & Kahn	15 30
Repairs to stage-wagon—A. Greeninger & Son	4 25
Freight—Southern Pacific Co.	2 18
Hotel Board—Hotel Metropole	7 00
Traveling expenses—E. S. Holden	1 25
Typewriting—A. E. Hope	2 00
Hauling freight—J. Wandell	8 98

Department of Lick Observatory—Continued.

1	electro—C. A. Murdock & Co.	$1 45
19½	lbs. putty—The Farmers' Union	68
	Cotton batting—The Farmers' Union	1 00
	Ammonia—The Farmers' Union	25
1	light glass, 15x20—California Art-Glass, Bending, and Cutting Works	1 50
	Freight—Southern Pacific Co.	52
	Hauling freight—F. P. Childs	2 61
	Expressage—Wells, Fargo & Co.	6 00
	Telegrams—Western Union Tel. Co.	1 35
	Hauling freight—F. H. Ross & Sons	67
	Freight—Southern Pacific Co.	25
	Hauling freight—J. Wandell	2 04
	Ammonia—C. E. Case	25
	Nit. silver—C. E. Case	1 25
	Salts—C. E. Case	25
1	gal. distilled water—Farmers' Union	35
4	pulleys—John Stock Sons	40
	Soap—Farmers' Union	50
6	burners—Farmers' Union	60
	Repairing burners—Farmers' Union	20
1	can chloride of lime—Farmers' Union	25
2	brushes—Farmers' Union	2 50
1	light glass, 22¼x30—J. P. Jarman	90
6	10″ files—Mangrum & Otter	1 20
2	brushes—Farmers' Union	2 00
5	lbs. litharge—Farmers' Union	45
	Freight—Southern Pacific Co.	25
	Hauling freight, etc.—J. Wandell	1 44
	Hauling freight, etc.—F. H. Ross & Sons	99
	Hauling freight—F. P. Childs	5 92
	Expressage—Wells, Fargo & Co.	6 00
	Freight—Southern Pacific Co.	6 11
	Customs charges—C. D. Bunker & Co.	12 00
	Hauling freight—J. Wandell	1 46
	Freight—Southern Pacific Co.	50
4	doz. negative cases—A. Fleishhacker & Co.	3 00
	Expressage—Wells, Fargo & Co.	12 20
	Hauling—F. P. Childs	6 18
	Paraffine matches—Farmers' Union	1 00
2	scrap books—H. S. Crocker Co.	2 00
1	stock and die—Dunham, Carrigan & Hayden Co.	2 00
8	machine taps—Dunham, Carrigan & Hayden Co.	2 40
	Postage—Dunham, Carrigan & Hayden Co.	15
1	gross shoulder screws—Mangrum & Otter	1 20
2	yds. green duck—L. Lion & Sons Co.	80
2	doz. brass bolts—Mangrum & Otter	3 60
12	lbs. flax twine—Farmers' Union	2 40
	Can axle-grease—Farmers' Union	10
2	and 8 oz. sacks—Farmers' Union	50
3	cans lye—Farmers' Union	25
5	gals. turpentine—Farmers' Union	2 75
2	calendar pads—E. H. Guppy & Son	70
1	ream 24x36 Manilla paper—Bonestell & Co.	3 60
	Freight—Southern Pacific Co.	25
4	cords wood, delivered—J. Wandell	18 00
	Postage stamps—A. L. Colton, P. M.	60 00
	40th number of L'Astronomie—B. Westermann & Co.	10 00
½	lb. pyro—Hirsch & Kahn	2 25
8	doz. 4x5 Seed's plates, No. 27—Hirsch & Kahn	4 95
20	doz. 8x10 Seed's plates, No. 27—Hirsch & Kahn	43 20
5	doz. 8x10 Seed's transparency plates—Hirsch & Kahn	10 80
	Postage on ½ lb. pyro—Hirsch & Kahn	17
12	jars, 12 crowfoot zincs, 12 crowfoot coppers—Paul Seiler Electrical Works	10 80
4	cu. yds. sand, delivered—J. R. Kincaid	16 00
	Cutting and hauling 4.48 cords wood—J. Wandell	20 16
2	line engravings—Bolton & Strong	3 00
6	bronzed locks—Mangrum & Otter	50
6	drawer pulls—Mangrum & Otter	25
1	4″ lead P trap—Mangrum & Otter	1 65
1	ft. 4″ lead pipe—Mangrum & Otter	45
4,975	Manilla envelopes—Blake, Moffitt & Towne	17 75
	Solder—Mangrum & Otter	25
2	lbs. sheet lead—Mangrum & Otter	70
	Labor, cutting, etc.—Mangrum & Otter	25

Department of Lick Observatory—Continued.

1 gal. distilled water—Farmers' Union			$0 25
Telegrams—Western Union Tel. Co.			6 23
Expressage—Wells, Fargo & Co.			1 90
Hauling freight, and express—F. P. Childs			1 14
Repairing boiler—D. Wight			1 25
Telephone message—Sunset Tel. & Tel. Co.			40
5 gals. turpentine—Farmers' Union			2 75
24 lbs. putty—Farmers' Union			84
Washing towels—Annie Kellegher			2 65
5 doz. Seed's lantern slide plates—Hirsch & Kahn			2 48
8 days work of one horse—J. Wandell			4 00
2 cords wood, delivered—J. Wandell			9 00
3 cords wood, delivered—J. Wandell			13 50
30 sq. ft. boiler felt—Mangrum & Otter			3 00
Washing L. O. towels, etc.—Mrs. R. Sullivan			6 90
Repairing wagon—Rosat & Verdier			2 25
2 quires buff blotting—Bonestell & Co.			2 80
10 yds. cheesecloth—Farmers' Union			80
5 lbs. glue—Farmers' Union			60
1 doz. 10″ hack-saws—Mangrum & Otter			80
Blacksmithing—R. A. Carroll			15 00
2½″ black nipples—Mangrum & Otter			1 25
Ivory soap—Farmers' Union			50
Toilet paper—Farmers' Union			50
60 negative cases—A. Fleishhacker & Co.			5 00
4 Adams brushes—Farmers' Union			5 00
1 fork—Farmers' Union			50
1 can axle-grease—Farmers' Union			10
21 lbs. putty—Farmers' Union			74
1 dandy brush—Farmers' Union			50
3 gals. japan varnish—Farmers' Union			3 60
6 Rochester chimneys—Farmers' Union			60
½ lb. sulphuric acid—Farmers' Union			20
10 lbs. coach black—Farmers' Union			2 50
12 lbs. putty—Farmers' Union			42
1 gal. japan—Farmers' Union			1 40
1 pt. ammonia—Farmers' Union			25
4 tires set—Rosat & Verdier			3 00
The Century Cyclopedia of Names—The Century Co.			13 00
Bill of Edward Stanford:	s.	d.	
Kempe's How to Draw a Straight Line	1	6	
Stoke's on Light	7	6	
Mayer & Barnard's Light	2	6	
Polarization of Light	3	6	
Modern Views of Electricity, Lodge	6	6	
A Century of Electricity	4	6	
Chemistry of Photography	6	0	
Postage	3	0	
	£1 15	0	8 52
Expense of sending machinist to Mount Hamilton to repair pump—Dow Steam Pump Works			2 00
Expense of sending machinist to Mount Hamilton to repair pump—Dow Steam Pump Works			6 50
Expressage—Patterson & Co.			1 25
1 lot paper—H. S. Crocker Co.			2 00
1 lot cardboard—H. S. Crocker Co.			1 00
2 ½-gal. bots. Eureka paste—Hirsch & Kahn			2 00
Telegram—Western Union Tel. Co.			55
Freight—Southern Pacific Co.			50
Hauling freight—J. Wandell			1 12
1 pkg. Vulcan tape—Mangum & Otter			75
1 reel insulated wire—Mangum & Otter			2 65
1 sheet zinc, 6′x3′			1 40
6 doz. Carbutt lantern plates—Farmers' Union			3 30
Freight—Southern Pacific Co.			2 63
Hauling freight—J. Wandell			4 04
Hauling freight—F. P. Childs			3 69
Expressage—Wells, Fargo & Co.			9 35
1 cord four-foot wood—J. Wandell			4 50
1 cord four-foot wood—J. Wandell			4 50
Dues, 1896—Astronomical Society of the Pacific			5 00
Repairing typewriter—G. G. Wickson & Co.			8 00

Department of Lick Observatory—Continued.

2 doz. 11 x 14 Seed's plates—Hirsch & Kahn	$10 00	
3 doz. 11 x 14 Seed's transparency plates—Hirsch & Kahn	15 00	
3 doz. 14 x 17 Seed's transparency plates—Hirsch & Kahn	27 00	
1 doz. 11 x 14 Carbutt B plates—Hirsch & Kahn	5 00	
1 doz. 14 x 17 Carbutt B plates—Hirsch & Kahn	9 00	
	$66 00	
Less 10%	6 60	
		$59 40
5 varions—Bolton & Strong		27 00
38 pieces ash—Glenwood Lumber Co.		24 30
300 ft. T. & G. pine—Glenwood Lumber Co.		9 00
10,000 letterheads—C. A. Murdock & Co.		18 00
5,000 letterheads—C. A. Murdock & Co.		14 00
1 Observatory, 1896—Lemcke & Buechner		3 50
1 Nature, 1896—Lemcke & Buechner		6 00
Annals of Mathematics, 1896—Lemcke & Buechner		2 00
Astronomical Journal, XVI—Lemcke & Buechner		5 50
Bulletin Astronomique, 1896—Lemcke & Buechner		4 50
24 boxes—A. Fleishhacker & Co.		1 32
5 doz. boxes—A. Fleishhacker & Co.		18 75
Bill of Hicks-Judd Co. for binding:		
12 8vos, half roan	$7 80	
2 12mos, half roan	70	
1 4to, half mor.	1 35	
1 4to, half mor.	1 35	
1 4to, half W. G. buff	1 10	
1 8vo, half W. G. buff	85	
1 8vo, cloth	65	
3 small folios	4 50	
2 small folios, half roan	3 10	
15 4tos, half roan	13 50	
		34 90
62½ lbs. red Cove square flax packing—Dunham, Carrigan & Hayden Co.		25 00
1 brass bell—L. Foard		15 00
5,000 blank cards—Blake, Moffitt & Towne		6 30
5,000 envelopes, No. 6—Blake, Moffitt & Towne		7 60
60 doz. 8x10 Crown plates, 40 doz. 3¼x4¼ Crown plates—G. Cramer Dry Plate Works		137 70
Journal of Astrophysics—University of Chicago		4 00
Rock salt—Farmers' Union		25
1 gal. distilled water—Farmers' Union		30
1 qt. ammonia—Farmers' Union		25
Sapolio—Farmers' Union		25
Toilet paper—Farmers' Union		1 00
1 box candles—Farmers' Union		2 30
1 gal. distilled water—Farmers' Union		30
2 No. 14 oilers—Farmers' Union		80
2 No. 16 oilers—Farmers' Union		1 30
5 lbs. litharge—Farmers' Union		45
Marigold seed—Farmers' Union		25
California poppy seed—Farmers' Union		25
Hauling freight—J. Wandell		5 52
Hauling freight—J. Wandell		1 30
Freight—Southern Pacific Co.		10 56
Freight—Southern Pacific Co.		55
50 ft. oak molding, ½″—D. Rinaldo		2 00
20 ft. oak molding, 1″—D. Rinaldo		1 00
2 hanks sash cord—Cherrie & Co.		1 40
1 doz. hack-saw blades—Cherrie & Co.		85
2 mucilage bottles—E. H. Guppy & Son		1 00
24 lbs. B. G. seed—Farmers' Union		3 00
6 Rochester chimneys—Farmers' Union		60
10 doz. lantern slide cover-glasses—Farmers' Union		4 00
6 doz. lantern slide cover-glasses—Hirsch & Kahn		2 00
2 doz. drawer pulls—Mangrum & Otter		1 00
1 keg 4d nails—Mangrum & Otter		4 00
1 keg double-pointed tacks—Mangrum & Otter		25
6 10″ mill files—Mangrum & Otter		1 50
1 contact breaker—A. F. Poole		10 00
3 burners—Farmers' Union		45
Freight—Southern Pacific Co.		5 40
Telephone message—Sunset Tel. & Tel. Co.		30
Telegram—Western Union Tel. Co.		1 14

Department of Lick Observatory—Continued.

Hauling freight—J. Wandell		$7 01
Hauling freight—J. Wandell		7 30
1 lantern—Farmers' Union		40
6 tin pie plates—Farmers' Union		25
2 electros—Charles Scribner's Sons		1 80
20 sheets tag board—Bonestell & Co.		2 00
20 sheets straw board—Bonestell & Co.		2 00
Cartage—Bonestell & Co.		25
1 quire paper—H. S. Crocker Co.		4 00
1 gal. benzine and case—Farmers' Union		40
Hauling freight—J. Wandell		3 95
1 bottom tap—Dunham, Carrigan & Hayden Co.		2 60
Work at Crossley dome—Henry Soto		1 00
6/10 cord of wood—J. Wandell		2 70
3 8/10 cords wood—J. Wandell		17 10
Freight—Southern Pacific Co.		25
Hauling freight—L. Bernal		14 00
Hauling freight—J. Wandell		5 04
22 lbs. 1¼″ nuts—Farmers' Union		1 32
1 car bit, 9/16″—Cherrie & Co.		75
1 car bit, 11/16″—Cherrie & Co.		85
1 car bit, 13/16″—Cherrie & Co.		1 00
23 lbs. ½″ round iron—Farmers' Union		61
36 lbs. ⅝″ round iron—Farmers' Union		90
73 lbs. ¾″ round iron—Farmers' Union		1 64
119 lbs. 1½″ rope—Farmers' Union		11 90
¾ lb. ½″ washers—Farmers' Union		06
1¾ lbs. ⅝″ washers—Farmers' Union		10
2⅜ lbs. ¾″ washers—Farmers' Union		16
2¾ lbs. T nuts, ½″—Farmers' Union		17
14½ lbs. nuts, ⅝″ and ¾″—Farmers' Union		72
542 lbs. blacksmith coal—Farmers' Union		4 88
300 lbs. old lead—Mangrum & Otter		14 25
Hauling freight—L. Bernal		6 90
4 doz. boxes, 4½x3½—A. Fleishhacker & Co.		3 00
6 doz. boxes, 10x8x1¼—A. Fleishhacker & Co.		7 50
7 doz. boxes, 8½x6½x1¼—A. Fleishhacker & Co.		7 00
72 boxes, 5x4x1¼—A. Fleishhacker & Co.		3 96
1,000 ft. lumber—Glenwood Lumber Co.		27 00
500 ft. lumber—Glenwood Lumber Co.		13 50
1 base plate—O'Connell & Lewis		150 00
Making 12 stud bolts—David Wight		2 00
Iron and 12 nuts—David Wight		1 00
Cutting threads and topping nuts—David Wight		4 00
Himmel und Erde, VIII—Mayer & Müller		3 88
Postage on Comptes Rendus—Gauthier, Villars & Co.		2 76
3 doz. 5x7 Seed's plates, No. 27—Hirsch & Kahn		2 97
15 lbs. insulated wire—John A. Roebling's Sons Co.		2 97
1 copy Creele's Reduction Tables, half morocco—E. S. Holden		3 50
24 ¾x2¾ C. bolts—Farmers' Union		3 84
24 ⅝x2¾ C. bolts—Farmers' Union		2 40
Hauling freight—L. Bernal		1 62
Hauling lumber—L. Bernal		21 30
24 sheets No. 1 sandpaper	Dunham, Carrigan & Hayden Co.	9 67
24 sheets No. 1½ sandpaper		
24 sheets No. 2 sandpaper		
6 locks B., No. 3800		
⅙ doz. No. 5210 locks, B		
1 gross screws, No. 1114		
1 gross screws, No. 1111		
2 doz. No. 40 hooks and eyes, 1½″		
2 doz. No. 41 hooks and eyes, 2″		
25 lbs. 6d finishing wire nails		
12 cupboard catches, No. 3210		
6 ½ pts. com. Hepger glue		
1 doz. drawer pulls, 406		
½ doz. 6″ saw files		
6 5″ saw files		
600 No. 43 upholster nails		
1 gross flat-head iron screws, 1½x10		
3 com. ax handles		
1 gross 1½x11 flat-head iron screws		
6 10″ mill files		
1½ doz. ½″ belt couplings—Dunham, Carrigan & Hayden Co.		4 00

Department of Lick Observatory—Continued

Bill of Farmers' Union:		
1 L.H. pipe die, ½″	$1 50	
1 L.H. pipe tap, ½″	1 00	
24 machine bolts, ¾x3½	2 14	
24 machine bolts, ⅝x3	1 46	
24 machine bolts, ⅝x2	1 32	
24 machine bolts, ⅝x2½	1 39	
24 machine bolts, ½x1½	86	
24 machine bolts, ½x1¾	92	
12 machine bolts, ⅝x½	62	
60 machine bolts, ½x2¼	2 40	
	$13 61	
Less	2 77	
		$10 84
Bill of G. H. Tay Co.:		
150 ft. 2″ dipped pipe, at 11½c.	$17 25	
200 ft. 1½″ dipped pipe, at 8¾c.	17 50	
2 doz. 1″ elbows, at $2\frac{6}{10}$c.	62	
2 doz. 1″ nipples, at 2¾c.	66	
1 doz. 1½″ tees, at $6\frac{6}{10}$c.	79	
6 1½″ unions, at 18c.	1 08	
18 1½″ elbows, at 5½c.	99	
2 doz. 1½″ nipples, at 5c.	1 20	
1 doz. 2″ elbows, at 7½c.	90	
1 doz. 2″ nipples, at 6½c.	78	
6 2½″ tees, at 17c.	1 02	
6 2½″ unions, at 45c.	2 70	
1 doz. 2½″ elbows, at 13c.	1 56	
1 doz. 2½″ nipples, at 14c.	1 68	
6 1½″ gate valves, at $1 57	9 42	
3 2½″ gate valves, at $4 80	14 40	
		72 55
Expressage—Wells, Fargo & Co.		2 35
Hauling freight—F. P. Childs		1 98
1 light glass, 24x37—J. P. Jarman		1 10
Telegrams—Western Union Tel. Co.		6 07
Expressage—Wells, Fargo & Co.		2 15
Hauling freight—F. H. Ross & Sons		3 27
Freight—Southern Pacific Co.		25
2 doz. Carmel soap—Goldberg, Bowen & Lebenbaum		2 50
5 gals. black paint—J. P. Jarman		4 50
1 doz. solio paper, 11x14—Taber Photo Co.		1 50
1 doz. solio paper, 14x17—Taber Photo Co.		2 25
Hauling freight—J. Wandell		3 18
3 sash brushes—Farmers' Union		50
1 lot rubber bands—E. H. Guppy & Son		1 00
Freight—Southern Pacific Co.		26
Retouching portrait of Chauvenet—Taber Photo Co.		1 00
1 light glass 13¾x19¼—J. P. Jarman.		40
1,532 ft. Oregon pine—Glenwood Lumber Co.		22 98
Bill of Hirsch & Kahn:		
5 doz. Carbutt A plates, 6½x8½	$8 25	
5 doz. Seed's transparency plates	8 25	
	$16 50	
Less 10%	1 65	
		14 85
6-qt. sprinkling pot—Farmers' Union		45
Hauling freight—J. Wandell		1 03
1 Scientific American, 1895—Lemcke & Buechner		20
1 Astronomical Journal, Nos. 340, 358—Lemcke & Buechner		40
Freight—Southern Pacific Co.		25
Telegrams—Western Union Tel. Co.		2 53
Hauling freight—J. Wandell		1 34
1 slide board, 8½x12—S. C. Partridge		50
Postage—S. C. Partridge		20
Freight—Southern Pacific Co.		25
12 lbs. rivets—Farmers' Union		90
Expressage—Farmers' Union		25
2 No. 73 hammers—Farmers' Union		1 40
20 lbs. rivets—Farmers' Union		1 50
48 lbs. rivets—Farmers' Union		1 44
400 rivets, ⅜x¼—Union Iron Works		60
1 half-tone—Bolton & Strong		6 45
3½ days labor—Eugene Gray		6 12

Department of Lick Observatory—Continued.

12 days labor—Eugene Gray		$21 00
12 days labor—Edw. James		21 00
Labor—Otto Pauli		15 00
Labor—E. Gray		9 62
Labor—E. James		9 62
100 lbs. iron—Mangrum & Otter		7 00
Labor, man and helper—Mangrum & Otter		2 25
4 doz 8x10 Karsak paper, and postage—Hirsch & Kahn		2 87
1 can axle-grease—Farmers' Union		10
1 blacksnake whip—Farmers' Union		80
Shoemaker's wax—Farmers' Union		25
1 pt. acetic acid—Hirsch & Kahn		25
1 pt. hydrochinon acid—Hirsch & Kahn		50
Freight—Southern Pacific Co.		1 04
29 lbs. zinc—Mangrum & Otter		2 90
Hauling freight—L. Bernal		5 68
Labor—O. Pauli		9 00
Labor—Edward James		4 37
Labor—O. Pauli		12 00
Labor—Edward James		7 87
Labor—Eugene Gray		7 87
Sand—J. R. Kincaid		6 64
400 lbs. ¼x¾ round-head rivets—Farmers' Union		30 00
20 lbs. 1½x½ round-head rivets—Farmers' Union		1 50
16 lbs. 2x½ round-head rivets—Farmers' Union		1 20
1 No. 7 W. A. Euryscope lense—Hirsch & Kahn		71 00
12 Mann's copy-books, 10x14—Payot, Upham & Co.		10 80
1 L'Astronomie, Vol. 8—Lemcke & Buechner		3 30
2 bracket lamps, No. 11—Nathan, Dohrmann & Co.		9 70
Bill of Hirsch & Kahn:		
6 doz. 14x17 Carbutt's A plates	$54 00	
4 doz. 14x17 Carbutt's B plates	36 00	
	$90 00	
Less 10%	9 00	
		81 00
320 lbs. double refined bluestone—Paul Seiler Electrical Works		6 80
12 6x8 jars—Paul Seiler Electrical Works		4 80
12 6x8 zincs—Paul Seiler Electrical Works		4 20
12 coppers—Paul Seiler Electrical Works		1 50
24 rubber bands—Paul Seiler Electrical Works		50
8 portraits of famous astronomers—Macmillan & Co.		12 00
50 yds. Napier matting—Rucker Bros.		30 00
100 yds. Napier matting—Rucker Bros.		60 00
74 yds. denim—C. M. Plum & Co.		14 80
Printing 200 copies of a cipher code—Astronomical Society of the Pacific		20 00
Bill of Hirsch & Kahn:		
1 11x14 deep printing frame	$2 16	
1 14x17 deep printing frame	2 70	
2 14x17 hard rubber trays	7 65	
1 gal. alcohol	2 70	
4 doz. 6½x8½ solio paper	1 98	
4 doz. 8x10 solio paper	2 70	
2 doz. 11x14 solio paper	2 25	
2 doz. 14x17 solio paper	3 33	
		25 47
2 8x10 Daisy plate-holders—Hirsch & Kahn		10 80
2 6½x8½ vulcanized rubber trays—Hirsch & Kahn		1 35
2 lbs. carbonate of soda—Hirsch & Kahn		27
1 lb. eikonogen—Hirsch & Kahn		3 55
2 18x22 H. R. trays—Hirsch & Kahn		10 35
2 Rochester metal lamps—T. P. Andrews		5 00
1 8x10 hard rubber tray—T. P. Andrews		92
1 oz. bromide of potash—T. P. Andrews		10
2 lbs. hydrochinon—T. P. Andrews		7 00
Bill of Yates & Co.:		
200 lbs. best white lead	$12 00	
10 gals. raw linseed oil	5 30	
5 gals. turpentine	2 35	
6 1-lb. cans burnt umber	60	
3 No. 25 Adams brushes	2 40	
3 No. 30 Adams brushes	3 15	
	$25 80	
Less 2%	50	
		25 30

Department of Lick Observatory—Continued.

Bill of J. Caire Co.:		
5 lbs. powdered alum	$0 50	
5 lbs. caustic potash	2 75	
10 lbs. sulphite of soda	2 00	
2 kegs hypo. soda	6 27	
1 glass mortar and pestle, 4″	30	
1 glass graduate, 16-oz.	55	
1 glass graduate, 8-oz.	30	
2 glass graduates, 4-oz.	40	
2 glass graduates, 2-oz.	30	
1 keg hyposulphite of soda, 112 lbs.	3 13	
15 lbs. sulphite of soda crystals, in 1-lb. bottles	3 00	
5 lbs. potassium carbonate, in 1-lb. bottles	1 00	
½ lb. hydrochinon	1 75	
1 15-gr. bottle chloride of gold	50	
1 lb. bottle sulphuric acid	25	
		$23 00
Bill of Pacific Pine Lumber Co.:		
200 ft. ½ x12 sugar pine, S. 2 S.	$11 11	
100 ft. ½″ ash, S. 2 S.	7 28	
100 ft. ¾″ ash, S. 2 S.	10 71	
100 ft. 1¼″ ash, S. 2 S.	10 82	
100 ft. 2″ ash, S. 2 S.	10 82	
100 ft. ¼″ Spanish cedar S. 2 S.	6 91	
100 ft. ½″ Spanish cedar, S. 2 S.	10 00	
100 ft. ¾″ Spanish cedar, S. 2 S.	15 05	
100 ft. 1″ Spanish cedar, S. 2 S.	15 14	
1 piece 3x18x18 Oregon pine, S. 2 S.	2 20	
500 ft. 1 x4 Oregon pine flooring	12 03	
		112 07
12 books, at 34c.—E. S. Holden		4 08
16 folio pamphlets, at 20c.—E. S. Holden		3 20
34 quarto pamphlets, at 20c.—E. S. Holden		6 80
72 octavo pamphlets, at 15c.—E. S. Holden		10 80
8 lbs. rivets—Farmers' Union		60
Expressage—Wells, Fargo & Co.		25
1 mirror—Rucker Bros.		2 50
50 tubes, 15 x 2—A. Fleishhacker & Co.		2 00
5 lbs. drop black—W. P. Fuller & Co.		90
6 Rochester chimneys—Farmers' Union		60
5 gals. turpentine—Farmers' Union		2 75
3 doz. hooks—Farmers' Union		75
2 boxes picture wire—Farmers' Union		25
Hauling freight—F. H. Ross & Sons		3 23
Expressage—F. H. Ross & Sons		7 65
10 lbs. litharge—Farmers' Union		90
3 lbs. burnt umber—Farmers' Union		60
Postage stamps—A. L. Colton, P. M.		75
1 lb. beeswax—Farmers' Union		40
Freight—Southern Pacific Co.		36
4 gals. black asphaltum—Farmers' Union		3 40
2 bullseye lanterns—San José Hardware Co.		1 20
1 piece wire screen—San José Hardware Co.		15
2 Columbian ink stands—H. S. Crocker Co.		1 50
1 art square—L. Lion & Sons Co.		4 00
Freight—Southern Pacific Co.		35
1 pr. bridles—F. M. Stern		4 00
3 awls—F. M. Stern		75
2 doz. hack-saw blades, 10″—Cherrie & Co.		1 50
1 adjustable hack-saw frame—Cherrie & Co.		1 00
Hauling—J. Wandell		3 28
1 burnisher polished—Will & Finck Co.		50
8 lbs. 1x⅜ round-head rivets—Farmers' Union		60
18 lbs. 1⅛x⅜ round-head rivets—Farmers' Union		1 35
7 lbs. 1⅜x⅜ round-head rivets—Farmers' Union		53
10 lbs. lampblack, dry—Farmers' Union		1 50
3 gals. alcohol—Brassy & Co.		9 00
1 demijohn—Brassy & Co.		75
1 lamp—Farmers' Union		2 25
7 days labor—Edward James		12 25
7 days labor—Eugene Gray		12 25
7 days labor—Otto Pauli		14 00
1 doz. ink, carmine—Payot, Upham & Co.		75
1 doz. ink, Higgin's—Payot, Upham & Co.		2 40

Department of Lick Observatory—Continued.

2 boxes McGill's F. H. fasteners. No. 2—Payot, Upham & Co.		$0 20
2 boxes McGill's F. H. fasteners, No. 3—Payot, Upham & Co.		20
2 qts. Carter's mucilage—Payot, Upham & Co.		90
12 pts. Carter's violet—Payot, Upham & Co.		2 40
4 doz. 8x10 Seed's plates, No. 27—Hirsch & Kahn		10 00
4 doz. 6½x8½ Seed's plates, No. 27—Hirsch & Kahn		5 00
4 doz. 5x7 Seed's plates, No. 27—Hirsch & Kahn		5 00
5 doz. 6½x8½ Carbutt's A plates—Hirsch & Kahn		8 00
4 doz. Carbutt's lantern-slide plates—Hirsch & Kahn		2 00
Oxford University Calendar, 1896—James Parker & Co.		1 60
1 No. 1 Orient oil-stove—John Stock Sons		5 50
5 cases coaloil—Farmers' Union		10 00
1 Ball's Atlas of Astronomy—Lemcke & Buechner		4 00
1 sash, 2x10—Glenwood Lumber Co.		2 00
6 yds. creton—Hart & Roberts		75
Hauling lumber—L. Bernal		15 00
24 yds. toweling—Farmers' Union		2 40
1 piece leather—F. M. Stern		85
Hauling freight—J. Wandell		1 36
1 qt. mucilage—E. H. Guppy & Son		1 00
4 shades—L. Lion & Sons Co.		3 40
Freight—Southern Pacific Co.		25
Repairs on tool-post—David Wight		1 50
50 ft. ½″ and 50 ft. 1″ molding—D. Rinaldo		4 50
1 doz. Fenotype plates—Hirsch & Kahn		1 08
Soap—Farmers' Union		50
1 10-v. lamp—Paul Seiler Electrical Works		95
2 doz. wicks—Farmers' Union		20
Assorted rubber bands—Payot, Upham & Co.		1 20
Hauling freight—J. Wandell		1 88
2 bars ½″ iron—Farmers' Union		50
2 bars ⅝″ iron—Farmers' Union		60
1 bar ¾″ iron—Farmers' Union		45
1 bar 1″ iron—Farmers' Union		70
3 pr. chest handles—Farmers' Union		75
3¾ lbs. sash cord—Farmers' Union		1 13
1 doz. boxes, 17¼x14¼x1¼—A. Fleishhacker & Co.		1 50
Freight—Southern Pacific Co.		25
Repairing Daisy plate-holder—S. C. Partridge		2 00
1 gross pens—Payot, Upham & Co.		75
Postage—Payot, Upham & Co.		04
Expressage—Wells, Fargo & Co.		19 70
Hauling—F. H. Ross & Sons		6 06
Telegrams—Western Union Tel. Co.		8 59
1 keg cut nails, 6d, finishing—Cherrie & Co.		4 25
1 keg cut nails, 8d, common—Cherrie & Co.		3 75
1 keg common nails, wire, 6d—Cherrie & Co.		4 10
Subscription for one year—Science		5 00
1 8-oz. glass funnel—John Taylor & Co.		14
2 4-oz. glass funnels—John Taylor & Co.		20
2 lbs. caustic potash—John Taylor & Co.		80
2 lbs. caustic soda—John Taylor & Co.		80
5 lbs. powdered alum—John Taylor & Co.		25
5 cords four-foot wood—J. Wandell		22 50
Bill of Hicks-Judd Co. for binding:		
1 folio, half mor.	$1 80	
1 4to, half mor.	1 35	
1 8vo, half mor.	90	
4 8vos, half w. g.	3 40	
5 4tos, half w. g.	5 50	
1 small folio, w. g.	1 35	
11 8vos, half roan	7 15	
12 4tos, half roan	10 80	
1 small folio, half roan	1 15	
1 medium folio, half roan	1 55	
4 books repaired and lettered	2 20	
	$37 15	
Less	25	
		36 90
3 10″ half-round files—Ingalls & Stock		44
3 12″ flat files—Ingalls & Stock		56
2 sacks charcoal—Cherrie & Co.		80
6 bars solder—Cherrie & Co.		1 80

Department of Lick Observatory—Continued.

2 doz. hack-saw blades—Cherrie & Co.	$1 50
6 mill saw files, 12″—Cherrie & Co.	65
2 round files, 12″—Cherrie & Co.	30
2 round files, 10″—Cherrie & Co.	25
2 round files, 6″—Cherrie & Co.	15
3 cords four-foot wood—J. Wandell	13 50
	$5,422 66
Salaries for the year ending June 30, 1896	14,986 26
	$20,408 91

DEPARTMENT OF MINERALOGY.

Expressage—Wells, Fargo & Co.		$1 25
Freight—Southern Pacific Co.		36
Expressage—Patterson & Co.		1 25
Expressage—Patterson & Co.		1 00
1 line engraving, 8x5½—Bolton & Strong		4 20
2 line engravings, small—Bolton & Strong		2 00
750 copies each, Nos. 10 and 11, Geology Bulletin, Vol. 1—Pacific Press Pub. Co.		73 00
Freight—Southern Pacific Co.		2 55
Expressage—Patterson & Co.		1 00
9 keys fitted—A. Erlandsen		2 05
28 sheets M. B. cream—Blake, Moffitt & Towne		1 12
1 ream Jap. woven folio—Blake, Moffitt & Towne		6 05
3,000 No. 6 envelopes—Blake, Moffitt & Towne		5 04
Freight—Southern Pacific Co.		1 07
Expressage—Patterson & Co.		50
Expressage—Wells, Fargo & Co.		1 00
3⅓ karats diamond bort—Victor Bishop & Co.		5 00
Freight—Southern Pacific Co.		88
Expressage—Patterson & Co.		25
Expressage—Patterson & Co.		75
Bill of Justinian Caire Co.:		
400 pieces plate glass, 1½″x1½″x¼″	$3 00	
1 oz. platinum bichloride solution, C. P.	1 20	
2 lbs. HNO_3, C. P.	50	
3 lbs. H_2SO_4, C. P.	75	
½ lb. ammonium carbonate, C. P.	25	
½ lb. potassium carbonate, C. P.	25	
6 tips for Bunsen burners	1 20	
2 pkgs. 5½-cm. filter paper	24	
3 pkgs. 11-cm. filter paper	60	
1 pkg. 15-cm. filter paper	27	
1 doz. test tubes, 5″x½″	20	
2 7″ shallow watch glasses	78	
		9 24
1 half-tone, 4x3—Bolton & Strong		3 00
5 small line engravings—Bolton & Strong		5 00
1 line engraving—Bolton & Strong		1 20
Clerical work—W. O. Smith		9 40
108 crystal models—Eimer & Amend		20 00
2 iron starting-boxes—W. H. Lozier		7 00
Expressage—Patterson & Co.		75
Bill of John Taylor & Co:		
6 lbs. HCl, C. P.	$1 15	
¼ lb. hydrofluoric acid, Merck's, C. P.	75	
½ lb. bisulphate of potassium, C. P.	55	
¼ lb. potassium hydrate, C. P.	25	
¼ lb. permanganate of potassium, C. P.	12	
1 oz. ammonium molybdate, C. P.	25	
6 Bunsen burners	1 80	
2 6″ porcelain evaporating dishes, deep form	60	
3 lbs. sodium wolframate, C. P.	2 40	
5 lbs. boracic acid, pure (crystals)	1 25	
1 lb. barium chloride, C. P.	30	
1½ lbs. cadmium sulphate	3 75	
		13 17
750 copies Bulletin Dept. of Geology, Vol. 1, No. 12—Pacific Press Pub. Co.		72 25
105 lantern slides—Edwin E. Howell		47 25
Expressage—Wells, Fargo & Co.		9 10
Expressage—Patterson & Co.		46
1 mineralogical specimen—H. W. Fairbanks		3 00

Department of Mineralogy—Continued.

Bill of George Breck:		
1 Criterion lantern	$60 00	
1 automatic electric lamp, 110-volt.	60 00	
	$120 00	
Less 10%	12 00	
		$108 00
3 half-tone plates—Bolton & Strong		7 50
4 line cuts—Bolton & Strong		4 00
1 line cut, 41 sq. in.—Bolton & Strong		4 10
1 line cut, 42 sq. in.—Bolton & Strong		4 20
200 ft. No. 12 covered wire—R. W. Lohmann & Co.		6 00
15-amp. switch, fuse block, insulators, etc.—R. W. Lohmann & Co.		1 50
Time, per contract—R. W. Lohmann & Co.		5 00
Printing 750 copies Bulletin Dept. of Geology—Pacific Press Pub. Co.		234 25
Postage stamps—John McCarthy, P. M.		5 00
Expressage—Patterson & Co.		2 25
		$692 94

DEPARTMENT OF BOTANY.

Customs charges—C. D. Bunker & Co.	$4 00
Expressage—Wells, Fargo & Co.	60
Expressage—Wells, Fargo & Co.	2 15
Expressage—Patterson & Co.	25
Postage stamps—John McCarthy, P. M.	10 00
1 No. 4 postal scale—Wilshire Safe and Scale Co.	6 15
1 doz. straight steel needles—Henry Kahn & Co.	60
1 oz. cover glasses, circles—Henry Kahn & Co.	1 08
1 oz. cover glasses, square—Henry Kahn & Co.	78
1 gross glass slips—Henry Kahn & Co.	90
12 glass rods—Henry Kahn & Co.	36
1 balsam bottle—Henry Kahn & Co.	20
1 double nose-piece—Henry Kahn & Co.	3 75
1 rm. Westlock folio—Dutton & Partridge	3 40
2 No. 8 waste baskets—Dutton & Partridge	83
1 quire blotting paper—Dutton & Partridge	1 75
3 lbs. B. C. twine—Dutton & Partridge	75
3 lbs. B. C. twine, No. 18—Dutton & Partridge	75
3 lbs. cotton twine—Dutton & Partridge	59
1 doz. glycerine jelly jars—Abramson-Heunisch Co.	50
6 8-oz. flint ointment pots—Abramson-Heunisch Co.	63
6 16-oz. flint ointment pots—Abramson-Heunisch Co.	1 12
6 1-lb. jam jars—Abramson-Heunisch Co.	62
6 8-oz. cond. jars—Abramson-Heunisch Co.	35
6 16-oz. cond. jars—Abramson-Heunisch Co.	50
2 salt mouth bottles—Abramson-Heunisch Co.	45
6 3¼ glasses—Abramson-Heunisch Co.	36
3 32-oz. red wide-mouth bottles—Abramson-Heunisch Co.	30
¼ gross 3 dr. homeo. vials—Abramson-Heunisch Co.	50
Corks for above—Abramson-Heunisch Co.	75
1 nest 3 beakers, 2 to 1½ ozs.—John Taylor & Co.	35
1 plain glass funnel, 4½″—John Taylor & Co.	20
⅓ lb. ¼″ glass tube—John Taylor & Co.	25
2 ft. I. R. tube, light—John Taylor & Co.	12
2 ft. I. R. tube, heavy—John Taylor & Co.	16
1 5″ file and handle—John Taylor & Co.	25
1 set cork-borers, ⅛″ to ½″—John Taylor & Co.	1 75
3 doz. taper corks, assorted—John Taylor & Co.	43
2 small burette spring clamps—John Taylor & Co.	50
1 4x4 battery jar—John Taylor & Co.	25
6 naturalist's tubes, ¾x2—John Taylor & Co.	20
6 naturalist's tubes, ½x2—John Taylor & Co.	17
2 doz. round wicks—C. C. Riedy	15
12 ft. portable tubing—Thos. Day & Co.	1 20
2 gum sockets—Thos. Day & Co.	50
3 ozs. Anthony's neg. cotton—Langley & Michaels Co.	1 80
¼ lb. chloral hydrate—Langley & Michaels Co.	37
1 sheet asbestos—Sanborn, Vail & Co.	10
1 gross Est. pens—Sanborn, Vail & Co.	68
3 8-oz. gl. stop. bottles—J. Caire Co.	55
2 doz. 6-oz. ex. W. M. bottles—J. Caire Co.	1 00
6 tubes, ½″ diam.—J. Caire Co.	30
1 grad. cylinder, 250 cc.—J. Caire Co.	1 00

Department of Botany—Continued.

1 lb. chloroform—J. Caire Co.		$0 85
1 lb. potash alum—J. Caire Co.		05
1 lb. carbolic acid, cryst.—J. Caire Co.		50
6 4″ glass pipettes, rubber bulb—J. Caire Co.		25
6 6″ glass pipettes, rubber bulb—J. Caire Co.		37
5,000 coin bags—A. Zellerbach & Sons		2 95
10,000 seed bags—A. Zellerbach & Sons		3 92
6 wood stools—Indianapolis Furniture Co.	$4 50	
6 pine tables—Indianapolis Furniture Co.	9 00	
	$13 50	
Less	25	
		13 25
1 volume "Sylva of North America"—Houghton, Mifflin & Co.		25 00
Expressage—Patterson & Co.		4 25
6 ½-pt. specimen jars—Abramson-Heunisch Co.		50
6 1-oz. salt mouths—Abramson-Heunisch Co.		75
6 4-oz. salt mouths—Abramson-Heunisch Co.		82
1 doz. 2-oz. French squares and corks—Abramson-Heunisch Co.		20
1 copper box with slide rack—J. Caire Co.		2 25
1 wooden vial rack—J. Caire Co.		40
10 rms. mounting paper—Cambridge Botanical Supply Co.		47 00
Postage stamps—John McCarthy, P. M.		10 00
Expressage—Wells, Fargo & Co.		25
Centuries VII and VIII, Fungi Columbiani—J. B. Ellis		12 00
Expressage—Wells, Fargo & Co.		1 00
Expressage—Patterson & Co.		50
6 gals. LePage's glue—J. Caire Co.		8 40
6 Bausch & Lomb AA4 microscopes, with double nose-piece—C. C. Riedy		177 95
Bill of John Taylor & Co.:		
2 doz. wash bottles, 16 oz. (similar to Queen & Co.'s pattern)	$9 00	
1 casserole (porcelain handle), 1,000 cc.	1 00	
6 beakers, 100 cc., with lip	48	
1 filter stand, hard wood, oiled (adjustable rack for 4 funnels)	1 15	
1 Wedgewood mortar and pestle (No. 3 Whitall & Tatum, 6″ across top)	70	
500 cc. pyroligneous acid	35	
1 lb. xylol, pure	65	
1 oz. methyl blue (Grübler's)	90	
1 oz. methylene blue (Grübler's)	85	
8 ozs. salicytate of soda	38	
1 lb. eau de labarraque	37	
1 oz. alcanna root	20	
		16 03
Customs charges—C. D. Bunker & Co.		1 38
		$388 07

DEPARTMENT OF PHYSICS.

Expressage—Patterson & Co.		$0 25
Marine insurance—Balfour, Guthrie & Co.		40
1 strip sheet lead, ¼x1⅛x10 ft.—Pacific Tool and Supply Co.		1 50
1 bar solder, 2½ lbs.—Pacific Tool and Supply Co.		49
1 Stubs' saw blade, 8″—Pacific Tool and Supply Co.		30
1 box candles—Merriam & Co.		85
Bill of Jas. R. McDonald & Co., in marks; total in dollars and cents:		
	Marks.	
1 telescope objective, No. 17	8.00	
4 telescope objectives, No. 19	56.00	
5 telescope oculars, No. 55	50.00	
5 cross lines for oculars, No. 80	15.00	
	Mks. 129.00	
Discount 10%	12.90	
	Mks. 116.10	
Discount 2%	2.32	
	Mks. 113.78	
1 spectroscope	95.00	
	Mks. 208.78	
Freight, packing, commission, etc.	37.55	
	Mks. 246.33	59 73

Department of Physics—Continued.

Freight—Southern Pacific Co.		$5 66
Expressage—Patterson & Co.		75
3 oz. citr. iron and ammonia—Kirkland & Trowbridge		45
3 oz. red prussiate potash—Kirkland & Trowbridge		30
30 wood seat stools—Indianapolis Furniture Co.		18 75
20 tables—Niehaus Bros. & Co.		85 00
Expressage—Patterson & Co.		3 00
3 ft. 1½″ poplar—Allen & Higgins Lumber Co.		1 10
1 block plane—Schmitt & Zehner		90
2 Vernier calipers—John Taylor & Co.		2 00
150 ft. ⅝″ redwood, ¼ round—G. C. Pape		75
1 piece hard, black rubber, 5¼ lbs.—Pacific Tool and Supply Co.		6 56
3 ft. sawed brass, 3¼ lbs.—Pacific Tool and Supply Co.		98
2 ft. red rubber rod, ½ lb.—Pacific Tool and Supply Co.		63
½ ream No. 12 mimeograph paper—United Typewriter and Supplies Co.		14 00
2 1-lb. cans black ink—United Typewriter and Supplies Co.		2 80
2 small bots. mimeograph varnish—United Typewriter and Supplies Co.		40
4 sheets perforating silk—United Typewriter and Supplies Co.		1 44
10 yds. cheesecloth—Max Greenhood		50
1 gal. E. C. No. 2 paint—Paraffine Paint Co.		1 50
Bill of C. F. Marwedel:		
Round brass rod (hard):		
6 rods, ¼″, 10 ft. long; 3 rods, ½″, 10 ft. long; 1 rod, ⅝″, 10 ft. long; 1 rod, ¾″, 10 ft. long; 1 rod, 1½″, 3 ft. long	$10 48	
2 pieces sawed strip brass, ⅜″x ¾″, 6 ft. long; 1 piece sawed strip brass, ½″x ¾″, 6 ft. long	4 18	
1 whole piece sheet brass, No. 28, B. & S. gauge, 12″ wide	57	
1 oz. silver solder, thin sheet	1 25	
12 Eureka hack-saw blades, flexible back, 8″ between holes, about 14 teeth to the inch	55	
6 extra Star hack-saw blades, 20 teeth to the inch	30	
12 jeweler's hack-saw blades, 4″	15	
1 Armstrong tool-holder with 9 tools, in case No. A O	2 65	
1 each, Starrett's lock nut caliper, outside and inside, style 38–12, 39–10	2 38	
		22 51
Bill of American Electric Works:		
German silver wire, double silk covered, B. & S. gauge: $4\frac{14}{16}$ lbs. No. 16; $5\frac{1}{16}$ lbs. No. 20; 4¼ lbs. No. 25; 5¼ lbs. No. 27	$40 89	
10 lbs. No. 18 magnet wire, copper, double, cotton covered, B. & S. gauge	2 50	
10 lbs. No. 20 magnet wire, copper, double, cotton covered, B. & S. gauge	2 96	
5 lbs. No. 32 magnet wire, copper, double, cotton covered, B. & S. gauge	5 70	
20 lbs. annunciator wire, No. 16	3 50	
10 lbs. annunciator wire, No. 19	1 95	
1¼ lbs. rubber tape	81	
150 ft. 14 silk lamp cord, 300 ft. 18 silk lamp cord	9 15	
5 lbs. No. 19 copper wire	80	
5 lbs. No. 22 copper wire	88	
$5\frac{1}{16}$ lbs. No. 25 copper wire	1 01	
		70 15
960 lbs. ice—G. N. Martin		9 60
2 tuning forks—Clark, Wise & Co.		45
Bill of Pacific Tool and Supply Co.:		
Square brass rod (hard):		
1 rod ¼″, 10 ft. long	$0 45	
2 rods $\frac{5}{16}$″, 10 ft. long	1 26	
2 rods ⅜″, 10 ft. long	1 85	
2 rods ½″, 10 ft. long	3 24	
1 rod ⅝″, 10 ft. long	2 52	
1 piece round copper rod, ⅝″ diam., 1 ft. long	23	
1 piece round copper rod, 1″ diam., 1 ft. long	54	
Brass telescope tubing, best seamless:		
5 ft. seamless tubing to fit over $1\frac{5}{16}$ tubing	1 40	
3 ft. ¾″ seamless, $\frac{1}{20}$″ wall to telescope	54	
3 ft. $1\frac{1}{16}$″ seamless, $\frac{1}{32}$″ wall to telescope	66	
3 ft. 1″ seamless, $\frac{1}{20}$″ wall to telescope	66	
Emery cloth, Barton's best, 1 quire of each: Nos. 00, 0, 1, 1½, 2	2 50	
2 pieces 5″ diam. thick walrus hide	2 00	
1 Buffalo Tool Co. Knurling set, in case	5 00	
1 Skinner milling machine chuck, universal, 4″ diam., style 304-D, and face-plate casting	15 00	
1 10″ Stillson pipe-wrench	1 15	
Stubs' drill gauge, 1 each, number, 61 to 70 inclusive	40	

Department of Physics—Continued.

Bill of Pacific Tool and Supply Co.—Continued.		
1 5/16″ Stubs' drill gauge	$0 18	
1 13/32″ Stubs' drill gauge	25	
Files, Grobet, Swiss:		
1 hand, one safe edge, 10″ No. 0	50	
1 pillar, two safe edges, 6″ No. 1	20	
2 pillar, two safe edges, 6″ No. 4	50	
1 half-width pillar, two safe edges, 8″ No. 2	35	
1 half-round, 8″ No. 4	35	
2 round, 4″ No. 2	30	
1 three-square, 5″ No. 2	25	
1 three-square, 5″ No. 5	25	
1 hand, one safe edge, 8″ No. 2	35	
American files:		
1 hand, one safe edge, bastard, 10″	20	
1 float, two square edges, 8″	15	
1 half-round, second cut, 8″	15	
Stubs' broaches, 1 each, large diameter: 1/16″, ⅛″, 3/16″, ¼″, 3/32″	85	
5 lbs. hard copper wire, No. 16, B. & S. gauge	1 00	
5 lbs. hard German silver wire, No. 16, B. & S. gauge	3 00	
2 lbs. hard German silver wire, No. 19, B. & S. gauge	1 30	
3 ft. square aluminum rod, ¼″	50	
Machine screw taps, one each, ⅛″–40, 3/16″–32, 5/32″–36	60	
		$50 13
Bill of J. Caire Co.:		
¼ lb. tripoli	$0 05	
20 nests Griffin's glass beakers, No. 0 to 3	9 50	
6 4-qt. stoneware water-pitchers	2 00	
1 gal. black asphaltum varnish	80	
25 lbs. No. 6 lead shot	1 50	
1 Chesterman steel tape, 10 meters, divided on one side to millimeters	6 00	
¼ lb. rotten stone	05	
		20 00
Bill of John Taylor & Co.:		
1 doz. small compass jewels	$3 00	
10 lbs. soft glass tubing, ½″ No. 2, medium thickness, in at least 3 ft. lengths	4 50	
3 2-qt. agate-ware water-pitchers	1 65	
3 1½-qt. agate-ware water-pitchers	1 35	
2 doz. wide-mouth, glass-stoppered bottles, 8 oz.	2 50	
1 gal. benzine	40	
3 small bots. vaseline	25	
¼ lb. copper oxide	15	
2 lbs. caustic potash, in sticks	90	
10 lbs. ammonium nitrate	2 00	
2 doz. crowfoot zincs, at 15c.	3 60	
1 flask mercury	41 00	
1 box adamantine candles, 20 sets, 14 oz., 6's	2 00	
1 small bot. glass cement	20	
		63 50
Expressage—Patterson & Co.		5 75
200 lbs. castings—Oakland Iron Works		8 00
50 lbs. castings—Oakland Iron Works		2 50
2 Fairbanks' trip scales—Fairbanks, Morse & Co.		7 50
1 doz. No. 56 magnifiers—Nordman Bros.		3 00
1 flannel buff—Nordman Bros.		50
1 felt wheel—Nordman Bros.		60
1 bristle wheel—Nordman Bros.		45
1 brush—Nordman Bros.		75
1 qt. wood polish—H. D. Kelsey		1 00
1 qt. laquer—H. D. Kelsey		1 35
Exchange of two calipers—C. F. Marwedel		75
2 lbs. ether—H. Bowman & Co.		1 80
3 rods round brass ⅛—Pacific Tool and Supply Co.		40
1 bar flat brass ¼″ x ⅝″—Pacific Tool and Supply Co.		1 01
1 gross R. H. brass machine screws—Pacific Tool and Supply Co.		40
110 gals. coal oil—Pacific Tool and Supply Co.		16 50
Customs charges—C. D. Bunker & Co.		4 00
Freight—Southern Pacific Co.		2 40
Expressage—Patterson & Co.		50
36 pieces ¾ x 3⅜ x 10 ft., T. & G. bd. cedar—Taylor & Co.		7 20
11 pieces ¾ x 3⅜ x 12 ft., T. & G. bd. cedar—Taylor & Co.		2 20
8 photos. of the normal spectrum of the magnesium arc—Northwestern University		3 00
520 lbs. ice—G. N. Martin		5 20

Department of Physics—Continued.

3 Morgan's mucilage pots and brushes—Payot, Upham & Co.		$1 00
Bill of Bausch & Lomb Optical Co.:		
6 lenses, ¼″ diameter	$4 50	
6 lenses, ½″ diameter	4 50	
12 lenses, 2″ diameter	7 20	
6 lenses, ¾″ diameter	4 50	
4 lenses, 3″ diameter	3 00	
	$23 70	
Less 25%	5 92	
		17 78
Expressage—Wells, Fargo & Co.		35
2 lbs. extra soft flowing spelter—Dunham, Carrigan & Hayden Co.		40
1 lb. pulverized borax—Dunham, Carrigan & Hayden Co.		15
1 quire sandpaper, each 00, 0, 1, 1½, 2—Dunham, Carrigan & Hayden Co.		65
3 Stubs' hack-saw blades, 8″—Dunham, Carrigan & Hayden Co.		69
1 8″ B. & S. drop forge—Dunham, Carrigan & Hayden Co.		30
1 doz. plumb seals—Dunham, Carrigan & Hayden Co.		50
1 Sunset shingling hatchet, No. 3.—Dunham, Carrigan & Hayden Co.		40
2 straight-shank twist drills—Dunham, Carrigan & Hayden Co.		1 20
1 gross brass wood screws—C. F. Marwedel		60
3 brushes—Chas. B. Wells		1 00
225 lbs. ice—G. N. Martin		2 25
2 gross R. H. brass wood screws—Pacific Tool and Supply Co.		91
2 gross R. H. brass machine screws—Pacific Tool and Supply Co.		1 45
1 machine screw—C. F. Marwedel		32
11 hard brass rods, various sizes—C. F. Marwedel		7 90
50 lbs. copper sulphate—John Taylor & Co.		2 37
½ lb. manganese chloride, C. P.—John Taylor & Co.		35
3 LeClanche battery cells—John Taylor & Co.		2 55
3 German porcelain evaporating dishes, 7½″—John Taylor & Co.		1 35
3 German porcelain evaporating dishes, 6″—John Taylor & Co.		75
Expressage—Wells, Fargo & Co.		3 15
Expressage—Patterson & Co.		1 50
1 set M. S. taps and dies, No. 2—Pacific Tool and Supply Co.		5 20
3 gross round head wood screws, Nos. 2, 4, and 6—Pacific Tool and Supply Co.		1 15
5 gross fillister head screws, Nos. 2, 4, 6, 8, and 10—Pacific Tool and Supply Co.		2 09
2 gross round head machine screws, Nos. 6 and 8—Pacific Tool and Supply Co.		70
1 gross wood screws, No. 6, F. H.—Pacific Tool and Supply Co.		65
3 lbs. sulphuric ether—J. Caire Co.		2 10
10 lbs. paraffine—J. Caire Co.		1 05
10 lbs. tobacco foil—J. Caire Co.		1 90
1 5″ Rowland concave grating—J. A. Brashear		200 00
12 spools thread—Max Greenhood & Co.		50
1 Arkansas oilstone—Pacific Tool and Supply Co.		1 00
1 set hand-cut steel figures—Pacific Tool and Supply Co.		1 35
1 small countershaft—Pacific Tool and Supply Co.		2 25
6 ft. ⅛″ rubber tubing—Revere Rubber Tubing Co.		20
Expressage—Patterson & Co.		1 00
1 carboy sulphuric acid—John Taylor & Co.		4 41
Expressage—Patterson & Co.		1 85
Bill of J. Caire Co.:		
Wire, B. & S. standard wire gauge:		
2 lbs. No. 25 spring brass wire, B. & S. gauge	$0 57	
½ lb. No. 19 and ½ lb. No. 22 steel piano wire, B. & S. gauge	90	
2 lbs. 1″, No. 16 steel wire brads	20	
2 lbs. 1½″, No. 14 steel wire brads	15	
1 lb. 2″, No. 12 steel wire brads	08	
1 lb. 2″, No. 10 steel wire brads	07	
6 papers double-point, tinned tacks, No. 10	30	
2 cans commercial sulphuric ether, 3 lbs. each	4 32	
2 cans, ½ pt. Le Page's liquid glue	38	
2 pkgs. (200) cut filters (French or Amer.), 10″	50	
2 pkgs. (200) cut filters (French or Amer.), 7½″	36	
2 pkgs. (200) cut filters (French or Amer.), 6″	32	
2 gross corks, best quality, assorted sizes, from ¼″ to 1″ diam., larger end	60	
20 lbs. bichromate of potassium	3 00	
2 doz. wooden meter rods, divided to millimeters on one side, to inches and eighths on the other	7 80	
½ oz. platinum foil, No. 40 B. & S. gauge	9 00	
9½ cwt. platinum wire, No. 25 B. & S. gauge	6 65	
		35 30
Bill of John Taylor & Co.:		
1,000 Dennison's gummed labels, No. 209	$0 85	
1,000 Dennison's gummed labels, No. 201	85	

Department of Physics—Continued.

	Bill of John Taylor & Co.—Continued.		
2	chamois skins, fine quality	$1 60	
150	lbs. sulphate of copper	6 75	
3	lbs. gum shellac, best quality, yellow	1 20	
1	lb. gum shellac, best quality, white	50	
			$11 75
8	6-oz. tubes black mimeograph ink—United Typewriter and Supplies Co.		4 80
2	blue record Remington ribbons—United Typewriter and Supplies Co.		1 20
10	rms. S. S. letter, punched—Dutton & Partridge		9 00
1	Reeve's wood pulley, 16x4x1$\frac{7}{16}$—Joshua Hendy Machine Works		1 65
1	piece ⅜ solid round belt, 12 ft.—Joshua Hendy Machine Works		1 20
6	16 candle 52-V. lamps—General Electric Co.		1 50
6	16 candle 110-V. lamps—General Electric Co.		1 50
10	key sockets—General Electric Co.		1 80
4	key sockets, wall—General Electric Co.		90
24	flat battery zincs, 1½″x 4″x ¼″—General Electric Co.		50
1	paint brush—Students' Coöp. Ass'n		20
6	brass butts and screws—Schmitt & Zehner		30
2	doz. brass screws—Schmitt & Zehner		05
1	set hand-cut steel figures—Pacific Tool and Supply Co.		2 25
	Expressage—Wells, Fargo & Co.		3 75
	Expressage—Patterson & Co.		1 00
	Marine insurance—Balfour, Guthrie & Co.		51
25	lbs. lead shot—J. Caire Co.		1 50
12	sets Griffin beakers, No. 0–2—John Taylor & Co.		3 00
2	rubber bulbs, open at one end—John Taylor & Co.		40
	Bill of Pacific Tool and Supply Co.:		
	Sawed strips hard brass, 2 strips each: $\frac{1}{16}$″x ¾″, 6 ft. long; ⅛″x ½″, 6 ft. long; ¼″x⅝″, 6 ft. long; ¼″x¾″, 6 ft. long	$4 05	
1	round hard brass rod, 1″ diam., 10 ft. long	4 80	
1	piece hard square brass, ¾″ square, 6 ft. long	2 43	
1	piece hard square brass, 1″ square, 3 ft. long	2 07	
1	piece hexagonal brass, ½″, 6 ft. long	99	
	Wire, B. & S. standard wire guage:		
2	lbs. No. 22, soft brass	54	
2	lbs. No. 16, soft iron	20	
2	lbs. No. 22, soft iron	20	
5	lbs. No. 14, soft copper, annealed	1 00	
	Pure, soft, Norway iron:		
1	piece 6″ wide, ⅛″ thick, 3 ft. long	1 50	
1	piece 1″ wide, ¼″ thick, 6 ft. long	75	
1	piece sheet zinc, No. 20, B. & S. gauge, 3′x 6′	1 50	
	Best hammered tool steel:		
1	piece, round, 1¼″ diam., 1 ft. long	1 15	
1	piece, round, 1″ diam., 1 ft. long	75	
1	piece, round, ¾″ diam, 1 ft. long	40	
1	Billings & Spencer drop-forged lathe dog, ⅜″	40	
1	Billings & Spencer drop-forged lathe dog, ½″	50	
1	Billings & Spencer drop-forged lathe dog, ¾″	55	
	Standard hand reamers, 1 each: ⅛″, $\frac{3}{16}$″, $\frac{5}{16}$″, ⅜″, ½″, ¾″	8 75	
1	Morse taper reamer, No. 1, full length 5⅞″, length of flute, 3½″	1 60	
1	hide-faced mallet, 1 lb. with extra faces	95	
1	hide-faced mallet, 2 lbs. with extra faces	1 15	
1	Morrill's saw set No. 1, improved	1 00	
1	round rod, aluminum, ¼″ diam., 3 ft. long	25	
1	sheet, $\frac{1}{16}$″ thick, 1 ft. x 2 ft., aluminum	1 75	
1	piece hard rubber, $\frac{1}{16}$″ thick, 1 ft. square	50	
2	pieces hard rubber, ⅛″ thick, 1 ft. x 2 ft.	2 00	
	Milling cutters (Brown & Sharpe):		
1	spiral milling cutter, diam. 2¼″, width face 1″, hole ⅞″	2 60	
1	side cutter, diam. 2¾″, width face ⅜″, hole ⅞″	1 95	
1	screw slotting cutter, diam. 2¾″, hole ¾″, gauge 17	15	
1	screw slotting cutter, diam. 2¾″, hole ¾″, gauge 20	15	
1	metal slitting saw, diam. 2½″, thickness $\frac{1}{16}$″, hole ⅞″	75	
1	metal slitting saw, diam. 2½″, thickness ⅛″, hole ⅞″	75	
1	metal slitting saw, diam. 2½″, thickness $\frac{1}{32}$″, hole ⅞″	85	
2	lbs. assorted iron washers, $\frac{3}{16}$″ to ½″ hole	30	
1	doz. 8″ Griffin hack-saw blades, 22 teeth to inch	65	
1	half-circle sink, size No. 1, 24″ long, 14″ wide, finish, gray enamel	3 25	
	Reeve's wood pulley: 1 12″ shifting, split, double arm, No. 1, width belt 2″, face 10″, exact size shaft, 1$\frac{7}{16}$″	2 15	
1	piece leather belting, 1″, single flat, 23 ft. long	1 38	
			56 66
	Customs entry—C. D. Bunker & Co.		4 00
			$967 33

Department of Physical Culture.

White's Physiological Manikin—J. M. Williamson		$25 00
Expressage—Patterson & Co.		25
2 6-ft. steel tapes—J. Caire Co.		3 00
1 Smyrna rug—C. W. Kinsey		3 00
Clerical work—M. S. Blanchard		7 30
Clerical work—A. E. Pierce		7 20
Clerical work—Geo. E. Ebright		4 00
Clerical work—E. J. Sherman		4 00
Bill of Narragansett Machine Co.:		
40 barbells, 5 lbs. each	$36 00	
3⅓ doz. barbell racks, mounted	5 00	
25 prs. 1-lb. Indian clubs	10 00	
25 prs. club-hooks, mounted	6 25	
50 prs. 2-lb. wooden dumbbells	25 00	
50 prs. bell-hooks, mounted	15 00	
1 No. 300 ankle machine	25 00	
	$122 25	
Less 25%	30 56	
	$91 69	
Freight charges	13 70	
		105 39
1 ream 28-lb. Ashland folio—Blake, Moffitt & Towne		3 64
1,000 No. 6 envelopes—Blake, Moffitt & Towne		1 68
Clerical work—Miss D. Whitehead		1 20
Clerical work—Edna Robinson		4 60
Clerical work—Estelle J. Barden		1 40
Clerical work—E. B. McLellan		4 00
Clerical work—Helen M. Grace		1 80
Freight—Southern Pacific Co.		4 70
Expressage—Patterson & Co.		2 50
Bill of George Tiemann & Co.		
1 Anderson's calipers	$5 50	
1 Camman's stethoscope	4 50	
1 Flint's hammer	75	
1 Flint's pleximeter	35	
	$11 10	
Less 25%	2 77	
	$8 33	
1 Mosher's pelvic oblique metre	35 00	
		43 33
1 sash—Johnson & Cavan		10 00
Freight—Southern Pacific Co.		2 40
Expressage—Patterson & Co.		25
Repairing 10 mattresses—J. B. Wilson		6 00
1 No. 7 rip saw—Schmitt & Zehner		2 00
1 level—Schmitt & Zehner		1 00
1 can Le Page's glue—Schmitt & Zehner		25
1 doz. snaps—Schmitt & Zehner		45
1 qt. Eureka oil—Schmitt & Zehner		20
1 paint brush—Schmitt & Zehner		35
1 pr. gas pliers—A. Erlandsen		75
1 set stencils—A. Erlandsen		1 25
1 doz. sapolio—A. Erlandsen		1 00
6 agate cups—A. Erlandsen		1 00
1 indexed record book—Le Count Bros.		1 50
16 prs. union roller door hangers—C. L. Maxwell & Sons		16 00
80 ft. wrought track and screws—C. L. Maxwell & Sons		5 60
14x4½ art square—Metropolitan Furniture Co.		15 00
Clerical work—R. H. Hutchinson		15 80
Clerical work—Frederick Boegle		13 80
Parke's Hygiene—P. Blakiston, Son & Co.		2 25
Higgins Opthal. Practice—P. Blakiston, Son & Co.		1 35
Van Harlingen on Skin—P. Blakiston, Son & Co.		2 48
Day on Headache—P. Blakiston, Son & Co.		90
Expressage—P. Blakiston, Son & Co.		50
"What our Girls Ought to Know"—Funk & Wagnalls Co.		76

Department of Physical Culture—Continued.

	£.	s.	d.		
1 set test worsteds—Narragansett Machine Co.				$4 00	
1 Seaver rod—Narragansett Machine Co.				4 00	
1 sphygmograph—Narragansett Machine Co.				25 00	
				$33 00	
Less 20%				6 60	
					$26 40
2 wand racks, mounted—Narragansett Machine Co.					1 50
Expressage—Wells, Fargo & Co.					4 50
5 lbs. rosin—H. D. Kelsey					25
2 doz. sapolio—Jos. McClain & Co.					1 80
10 gals. coaloil—Jos. McClain & Co					2 00
1 doz. cans lye—Jos. McClain & Co.					80
½ gal. sperm oil—Jos. McClain & Co.					75
Bill of E. Hawksley, in pounds, shillings and pence, total in dollars and cents:	£.	s.	d.		
1 Greenfield's cyrtometer	0	15	6		
1 double chest tape		5			
1 coxankylometer	2	2			
Box and packing		2	6		
	£3	5	0		15 92
Changing 16 doors and making 8 grates—C. C. Underwood					16 00
Expressage—Patterson & Co.					25
Clerical work—B. H. Donnell					5 00
Clerical work—M. H. Peck					5 00
Ruling (and paper) 650 blanks, 11x17 28-lb. Whiting folio—Hicks-Judd Co.					4 05
Binders for same—Hicks-Judd Co.					1 00
Binding 2 medical examination books—Hicks-Judd Co.					2 00
Covering and polishing desk—J. B. Wilson					3 00
Fitting keys—J. B. Wilson					1 75
1 Naché Trial Case—A. Steffanoni					25 00
6 hours' clerical work—E. Boegle					1 20
1 striking-bag—Clabrough, Golcher & Co.					8 00
Customs charges—Davies, Turner & Co.					5 13
Expressage—Wells, Fargo & Co.					1 00
Expressage—Patterson & Co.					25
Salaries for year ending June 30, 1896					3,229 67
					$3,693 05

COLLEGE OF LETTERS.

Salaries for the year ending June 30, 1896	$25,687 72

COLLEGE OF SOCIAL SCIENCES.

Salaries for the year ending June 30, 1896	$23,908 81

MUSEUM.

½ bbl. alcohol—C. Jost & Son	$15 78
2 coils wire—Schmitt & Zehner	20
2 spools copper wire—Schmitt & Zehner	20
6 doz. iron screw-hooks, assorted—Schmitt & Zehner	30
4 doz. brass cap hooks—Schmitt & Zehner	60
Awl handle—Schmitt & Zehner	10
4 awls—Schmitt & Zehner	05
1 lb. brads—Schmitt & Zehner	10
2 gimlets—Schmitt & Zehner	20
96 blocks—G. C. Pape	4 00
3 tables—H. Schellhaas	6 00
5 papers assorted tacks—Schmitt & Zehner	25
Assorted galv. and copper wire—Schmitt & Zehner	45
1 B. B. X. Continental microscope—Henry Kahn & Co.	45 00
1 camera lucida—Henry Kahn & Co.	8 25
1 dissecting microscope—Henry Kahn & Co.	8 25
1 paraffine bath—Henry Kahn & Co.	5 00
2 sets Bohemian cryst. dishes—C. C. Riedy	3 50
2 capped balsam bottles—C. C. Riedy	50
2 capped glass-stemmed bottles—C. C. Riedy	50
½ gross long 8-dram. vials—C. C. Riedy	1 50
¼ gross 8-dram. vials—C. C. Riedy	75
Glass-stoppered tincture bottles, 6 each: 1 qt., 1 pt, ½ pt., ¼ pt.—C. C. Riedy	3 60
8 iron brackets—W. T. Veitch & Bro.	7 00
Expressage—Patterson & Co.	75

Museum—Continued.

1 cylinder graduate 100 cc.—J. Caire Co.		$1 90
1 lb. caustic potash, commercial—J. Caire Co.		12
10 ft. rubber tube, ⅞—J. Caire Co.		90
19 yards cheesecloth—Max Greenhood		75
1 gross XX corks—C. C. Riedy		40
1 oz. haemotxylin, Delafield's—C. C. Riedy		20
4 oz. haemotxylin, Ehrlich's—C. C. Riedy		40
1 grm. xylol—C. C. Riedy		30
1 grm. Canada balsam—C. C. Riedy		30
1 condenser for microscope—C. C. Riedy		5 75
2 lenses—C. C. Riedy		3 00
1 doz. staining jars—C. C. Riedy		2 25
¼ gross short vials—C. C. Riedy		75
Expressage—Patterson & Co.		1 00
Freight—Southern Pacific Co.		2 40
1 bbl. alcohol—Crown Distilleries Co.		25 14
Expressage—Patterson & Co.		1 00
1 cylinder graduate, 25 cc.—John Taylor & Co.		33
1 porcelain evaporating dish, 4″—John Taylor & Co.		18
1 porcelain evaporating dish, 5″—John Taylor & Co.		25
1 porcelain evaporating dish, 6″—John Taylor & Co.		37
2 chemical thermometers—John Taylor & Co.		1 20
1 iron tripod, 2 ring—John Taylor & Co.		35
1 Bunsen burner, with movable collar—John Taylor & Co.		30
1 wood support—John Taylor & Co.		90
1 ¼-gal. glass funnel—John Taylor & Co.		28
Customs charges—C. D. Bunker & Co.		2 00
Marine insurance—Balfour, Guthrie & Co.		44
Customs charges—C. D. Bunker & Co.		4 00
Expressage—Patterson & Co.		1 00
Bill of J. R. McDonald & Co., in marks; total in dollars and cents:	Marks.	
10 pieces square preparation glasses, 4 cm. deep, 13 cm. high, 12 cm. broad	22.50	
15 pieces square preparation glasses, 5 cm. deep, 20 cm. high, 16 cm. broad	120.00	
10 pieces square preparation glasses, 3 cm. deep, 15 cm. high, 6 cm. broad	15.00	
10 pieces square preparation glasses, 3 cm. deep, 15 cm. high, 8 cm. broad	18.00	
5 pieces square preparation glasses, 8 cm. deep, 36 cm. high, 5 cm. broad	45.00	
	Mks. 220.50	
Discount, 15%	33.05	
	Mks. 187.45	
Packing, freight, etc.	67.95	
Commission	12.77	
	Mks. 268.17	65 03
Work as janitor—W. C. Maxwell		4 30
Salaries for the year ending June 30, 1896		1,050 29
		$1,290 61

LIBRARY.

	£.	s.	d.	
Customs charges—C. D. Bunker & Co.				$12 00
Expressage—Patterson & Co.				2 50
Bill of B. F. Stevens, in pounds, shillings, and pence; total in dollars and cents:				
Journal of Chemical Industry, Vol. 12		3	0	
English Illustrated Magazine, December, 1894		1	0	
Annals and Magazine, Natural History, January, 1895		5	0	
Postage on periodicals, second quarter, 1895		10	4	
Mathematical Society Proceedings, 504–8		6	8	
Commission		0	8	
Microscopical Quarterly, No. 148		10	0	
Mineralogical Magazine, No. 49		5	0	
Royal Society Phil. Trans., Vol. 185	1	2	6	
Royal Society Phil. Trans., B. pt. 2	1	3	2	
Commission		4	7	
Quarterly Journal of Mathematics, 107		5	0	
Royal Society Proceedings, No. 343		3	6	
	£5	0	5	24 60

Library—Continued.

Freight—Southern Pacific Co.		$0 25
One Bulletin de l' Herbier, 1895—H. Welter		4 15
One Annale de Chimie—H. Welter		1 52
Balance due on Electrician—Kenyon News and Postal Subscription Co.		2 00
Postage stamps—John McCarthy, P. M.		20 00
Proceedings, 1895—Academy of Natural Sciences of Philadelphia		5 00
Heinrich's Buchverzeichness, 1894—Mayer & Müller		1 83
Bill of Mayer & Müller, in marks; total in dollars and cents:		
	Marks.	
Allmann, Tunicale	2.00	
Baer, Ento. de Larve	1.30	
Buttohle, Entur. d. Eizelle	16.00	
Binding	2.50	
Carus, Entur. d. Ascidien	2.00	
Claparede, Anatomie Thiere	22.00	
Costa, Osserv. fisiol, etc.	4.00	
Binding	.60	
Dewitz, Præparate	4.00	
Binding	50.00	
Fauna and Flora d. Golf. v. Neapel	------	
Fischer, Lyna	1.50	
Fol, Schlumd	2.00	
Giard, l'emhyayen	3.00	
Grobben, Doliolum, etc.	8.80	
Binding	.50	
Hertwiz, Entw. d. Cellulose	3.50	
Nerven. d. Medusen	14.00	
Binding	3.00	
Thering, Nerven. d. Mollusken	28.80	
Keferstein u. Ehlers. Zoöl. Beitrage	12.80	
Binding	2.00	
Kowalensky, Entw. d. einpacken. Ascidien	7.20	
Prophera Listeri	3.00	
Krohn, Gattung, etc.	1.80	
Krolin, la generat. et le derul., etc.	2.00	
Kupfer, Tunicala	5.00	
Binding	.90	
Latrille, Tuniciers	10.00	
Lowig, Tunicier	1.50	
McIntoch	1.50	
Metschnitorff, Studien v. Atlas	16.00	
Meyer, über die Salpen	3.50	
Binding	.60	
Perrier	2.10	
Binding	2.00	
Schwann, Mikroscopical Researches	6.00	
Semper, Epidermis der Ascidien	2.00	
Verwen, Allgem. Physiologie	12.00	
Claus, Entw. d. Medusen	16.00	
Binding	2.25	
Crustacean	9.60	
Binding	1.50	
Gegenbauer, Schwimny	3.20	
Binding	.60	
Haeckel, Siphonophorm	15.00	
Binding	2.25	
Hatschek, Anneliden	10.40	
Binding	1.50	
Keferstun, niedere Seetticere	5.00	
Binding	1.50	
Binding	3.80	
	Mks. 334.70	81 16
Expressage—Patterson & Co.		75
Expressage—Wells, Fargo & Co.		9 96
Postage stamps—John McCarthy, P. M.		20 00
Expressage—Wells, Fargo & Co.		1 70
Expressage—Patterson & Co.		1 00
One Annales Philosophique T. V.—H. Welter		99
	s. d.	
Mathematical Society Proceedings, 509 to 517—B. F. Stevens	12 0	
Commission—B. F. Stevens	1 2	
Postage on periodicals, 3d quarter—B. F. Stevens	3 3	
	£0 16 5	4 00

Library—Continued.

California Illustrated Magazine, Dec., 1893—P. J. Healy		$0 10
California Illustrated Magazine, Jan., 1894—P. J. Healy		2 50
California Illustrated Magazine, Feb., 1894—P. J. Healy		25
California Illustrated Magazine, Mar., 1894—P. J. Healy		25
California Illustrated Magazine, April, 1894—P. J. Healy		25
Four yds. tracing cloth—Students' Coöp. Ass'n		1 40
Bill of Kenyon News Co.:		
American Architect, Imperial edition	$10 10	
American Chemical Journal	3 40	
American Geologist	3 55	
American Journal of Mathematics	4 25	
American Journal of Philology	2 50	
American Journal of Psychology	4 25	
American Journal of Science	5 00	
American Naturalist	3 65	
American Society of Civil Engineers	9 00	
Annals of Mathematics, University of Virginia	2 05	
Arena	2 60	
Art Amateur, with colored plates	3 50	
Astro-Physical Journal	3 90	
Atlantic Monthly	3 35	
Botanical Gazette	3 05	
Bulletin Geological Society of America	5 05	
California Architect	2 50	
Century Magazine	3 60	
Classical Review	2 60	
Cosmopolitan	95	
Decorator and Furnisher (Paid to December, 1896.)		
Education	2 65	
Educational Review	2 65	
Electrical Engineer, New York	2 50	
Engineering News	4 90	
Engineering Record	5 05	
Engineering and Mining Journal	4 00	
Forum	2 75	
Johns Hopkins Historical Studies	2 55	
Journal of American Chemical Society	4 25	
Journal of Association Engineering Societies	2 70	
Journal of Morphology	8 00	
Journal of Political Economy, Chicago	2 60	
Journal of Education, Boston	2 25	
Kindergarten Magazine	1 65	
Library Journal	5 05	
Modern Language Notes	1 45	
Monist	1 65	
Nation, New York	2 85	
New Education, Simpson & Co., New York	85	
New England Magazine	2 55	
North American Review	4 25	
Pedagogical Seminary (Vol. 3 due us.)		
Philosophical Review, New York	2 60	
Physical Review, New York	2 60	
Political Science Quarterly	2 60	
Popular Science Monthly	4 60	
Psychological Review	3 65	
Publishers' Weekly	3 05	
Railroad Gazette	4 00	
Review of Reviews	2 15	
School of Mines Quarterly	1 65	
School Review	1 40	
Scientific American and Scientific American Supplement	6 00	
Scribner's Magazine	2 60	
Yale Review	2 60	
(English)—		
Annals and Mag. of Natural History	7 50	
Athenæum	3 50	
Chemical News	4 25	
Dublin Review	5 00	
Economic Journal	5 50	
Electrician	7 00	
Engineer	8 10	
Engineering	8 10	
Gardener's Chronicle	3 60	
Geological Magazine	4 40	
Journal of Anatomy and Physiology	6 00	

Library—Continued.

Bill of Kenyon News Co.—Continued.		
Journal of Physiology	$5 50	
Longman's	1 75	
Macmillan's	2 65	
New Review	3 00	
Observatory and Companion	3 00	
Philosophical Magazine	7 75	
Temple Bar	3 00	
		$275 10
B. M. General Catalogue, 5 parcels; Subscription Catalogue, 1895, and commission—E. G. Allen, £3 15s. 5d.		17 99
Bill of Charles S. Greene, for periodicals for one year, beginning January, 1896:		
Critic	$2 90	
Harper's Monthly	3 15	
Mining and Scientific Press	2 40	
Overland	2 50	
Pacific Rural Press	2 40	
Blackwood, Contemp. Edinburgh Quarterly, Fortnightly, Ninteenth Century, Scottish and Westminster Reviews	27 35	
	$40 70	
Harper's for December, 1895	30	
		41 00
Expressage—Wells, Fargo & Co.		45
Expressage—Patterson & Co.		25
Freight—Southern Pacific Co.		84
American Economic Ass'n Transactions, Vol. 9—Macmillan & Co.		4 00
Annals, Vols. 7 and 8—American Academy of Political and Social Science		5 00

Bill of B. F. Stevens, for periodicals, in pounds, shillings, and pence; total in dollars and cents:	£.	s.	d.	
Chemical Society Journal, 1896	2	2	0	
English Catalogue, 1896		5	0	
Journal of Chemical Industry, 1896	1	10	0	
Messenger of Mathematics, 1896		12	6	
Mind		12	0	
Nature, 1896, and postage	1	8	0	
Economic Review, 1896, and postage		10	0	
	£6	19	6	34 18

Two copying books—Dutton & Partridge		1 60
One ream Manilla paper—Blake, Moffitt & Towne		2 75
Hinrich's Katalog—Mayer & Müller		1 81
Bill of Mayer & Müller, in marks; total in dollars and cents:	Marks.	
Goethe Jahr., Bd. 16		
Jahresber. d. chem. Techlologie, Bd. 40	19.20	
Binding	2.25	
Jahresber. Zoölogy, f. 1894	21.60	
	Mks. 43.05	10 44
Expressage—Wells, Fargo & Co.		30
Expressage—Patterson & Co.		25
Library blanks—Filmer-Rollins Electro Co.		3 00
Freight—Southern Pacific Co.		18 20
Expressage—Wells, Fargo & Co.		7 35
Expressage—Patterson & Co.		3 50
Freight—Southern Pacific Co.		4 35
Bill of Mayer & Müller, in marks; total in dollars and cents:	Marks.	
Philologie, Bd. 53	3.60	
Fortschrifte d. Physik	27.00	
Civilinginieur, 1894	15.50	
Adatom. Anzeiger. Bd. IX	6.30	
Jahrbuch f. Pædagogik	5.40	
Memoires de l' Acad. de St. Petersburg	3.15	
Jahrbuch d. Berg u. Hüttenwesen	7.20	
Anatom. Anzeiger Erganzungsheft, Bd. X	3 60	
Acta Mathematica, 11	13.50	
Anglia, 18	18.00	
Annalen Mathematio., 46	18 00	
Annalen u. Physik	32.40	
Beiblätter dazu	18.00	
Verhandlungen d. Physik	3.60	
Annali Matemativa, 23	14.40	
Anzeiger Anatomischer	14.40	

Library—Continued.

Bill of Mayer & Müller—Continued.	Marks.	
Arbeiten d. Gesundheitsamts	18.90	
Archiv Mathematik	9.45	
Archiv neuere Sprachen	14.40	
Archiv Physiologie Bd.	90.00	
Bannen neue	6.50	
Berichte der chem. Gesellshaft	36.00	
Bibliotheca Mathemativa	3.60	
Blatter Rhein f. Erziehung	7.20	
Centralblatt f. Agricultur	18.00	
Centralblatt Biologisches	18.00	
Centralblatt Botan	25.20	
Centralblatt Chemisches	54.00	
Centralblatt Literarisches	27.00	
Civilinginieur	13.50	
Crelles Journal f. Mathematik	10.80	
Dingler s Journal	32.40	
Estia	22.00	
Forschungen d. Agriculturphysik	17.10	
Gartenlaube	3.60	
Giornale Vinicole	12.00	
Jahrbuch d. geolog. Reichsanstalt	14.40	
Jahrbuch v. Mathematik	28.80	
Jahrbuch f. Mineralogie. Beilage	13.00	
Jahrbuch Mineralogie	36.00	
Jahrbucher f. Philologie	27.00	
Jahresbericht d. Alterthem	28.80	
Industrie Chemische	18.00	
Journal f. Praktische Chemie	21.60	
Register zu 1870–74	8.10	
Lehrproben u. Lehrgänge	3.60	
Literaturblatt f. germ. Philologie	10.00	
Museum f. Philologie Rhein	12.60	
Nachrichten Astronom	15.00	
Paleontographica	54.00	
Paul & Braune Beitrage	15.50	
Peterman. Mitheilungen	21.60	
Philologus, Bd. 54	15.30	
Revueil d. travaux Chimiques	10.50	
Rundschau deutsche	21.60	
Skizzenbuch f. d. prakt. Maschienenkonstruction	9.00	
Studien Englische	15.50	
Studien Philosophische	10.80	
Über Land und Meer	8.10	
Verhandlung d. Geverbefleiss	27.00	
Versuchsstationen Landwirtschaftl	10.80	
Vierteljahresschrifft Philosophie, 29.19	10.80	
Vierteljahresschrifft f. Chemie	11.70	
Weinlaube	12.00	
Zeitschrift f. deutsches Alterthum	16.20	
Zeitschrift f. Berg, etc	18.00	
Zeitschrift Oester. f. Berg, etc	21.60	
Zeitschrift f. angew. Chemie	18.00	
Zeitschrift f. anorg. Chemie	21.60	
Zeitschrift f. physikal Chemie	25.20	
Zeitschrift f. morgenl. Gesellschaft	13.50	
Zeitschrift Historische	10.15	
Zeitschrift d. Vereins deutscher Ingenieure	28.80	
Zeitschrift d. Oester. Ing. Vereins	18.00	
Zeitschrift f. Instrumentenkunde	18.00	
Zeitschrift f. Krystallographie	36.00	
Zeitschrift f. Mathemat. 1895. Suppl.	6.85	
Zeitschrift f. Nahrungsmittel-Unter.	9.00	
Zeitschrift f. deutsche Philologie	13.50	
Zeitschrift romanische Philologie	18.00	
Zeitschrift Philosophie	10.80	
Zeitschrift f. Psychologie	40.50	
Zeitschrift vergl. Sprachforschung	14.40	
Zeitschrift math. naturw. Interricht	10.80	
Zeitschrift Zoölogie	72.90	
Zeitung Berg & Hüttenmann	23.40	
Zeitschrift f. analyt. Chemie	32.40	
Porto f. Zeitschriften	215.10	
	Mks. 1,831.50	$444 14

Library—Continued.

2,000 envelopes—M. Brown & Sons		$9 00
Library notes, Vol. 4—Kenyon News Co.		90
Bill of H. Welter:	Francs.	
Annales de Chimie	36.00	
C. R. des Sciences	35.00	
C. R. des Sciences, mor. and polit.	27.00	
Journal des économistes	39.00	
Journal de Mathematique	35.00	
Revue des Mondes	61.00	
Revue Philosophique	35.00	
Revue Scientifique	36.50	
Romanie	23.00	
Revue gen. de botanique	22.50	
Progres agricole and viticole	14.50	
Thirteen packets	3.25	
	Fcs. 367.75	72 11
Postage stamps—John McCarthy		20 00
Expressage—Patterson & Co.		25
Annual Literary Index, 1895—Publishers' Weekly		3 50
Postage—Publishers' Weekly		18
Proceedings of the Boston Society of Natural History		4 00
Expressage—Wells, Fargo & Co.		6 40
Expressage—Patterson & Co.		1 25
Southern Pacific Co.		25
Postage on periodicals, October, 1895, to March, 1896—B. F. Stevens		1 24
Transactions Am. Philol. Ass'n, Vol. 26—Ginn & Co.		2 00
Academy, July 13, 1895—Kenyon News and Postal Subscription Co.		10
Economist, 1:4:96—Kenyon News and Postal Subscription Co.		20
Notes and Queries, index to Vol. 8—Kenyon News and Postal Subscription Co.		15
Saturday Review, 1:11:96—Kenyon News and Postal Subscription Co.		15
Spectator, 1:18:96—Kenyon News and Postal Subscription Co.		15
Expressage—Wells, Fargo & Co.		35
Expressage—Patterson & Co.		1 50
Salaries for the year ending June 30, 1896		4,380 00
		$5,578 34

UNIVERSITY PRINTING OFFICE.

Expressage—Patterson & Co.		$2 25
1/16 lb. 8-point Ronaldson fractions—Pacific States Type Foundry		22
¼ rm. mourning note—Blake, Moffitt & Towne		75
2 rms. 24x36 S. S. & C. tint, cut ¼—Blake, Moffitt & Towne		8 96
1 rm. 24x36, 65 lb. tint, cut ¼—Blake, Moffitt & Towne		5 20
2 rms. 28 Whiting folio—Blake, Moffitt & Towne		8 96
2 rms. 16 Whiting cap—Blake, Moffitt & Towne		5 12
100 sheets 120 cream M. B.—Blake, Moffitt & Towne		4 50
3 rms. 20x42 70 S. S. & C. tint—Blake, Moffitt & Towne		16 80
200 sheets 50 silver gray cover—Blake, Moffitt & Towne		1 60
Expressage—Patterson & Co.		25
Expressage—Patterson & Co.		5 75
5,000 No. 9 envelopes—Blake, Moffitt & Towne		6 00
5,000 No. 10 envelopes—Blake, Moffitt & Towne		6 90
50,000 tag board—Blake, Moffitt & Towne		2 25
6,000 tag board, 5½x4¾, perforated—Blake, Moffitt & Towne		10 50
Expressage—Patterson & Co.		3 00
1 paper-knife ground—Will & Finck		75
11 yds. Canton flannel—Strauss & Baum		1 00
Bill of Palmer & Rey Type Foundry:		
25 lbs. 6-pt. French Old Style	$13 50	
25 lbs. 12-pt. French Old Style (No. 2 Central)	9 50	
25 lbs. 30-pt. Latin Antique	12 50	
25 lbs. 36-pt. Latin Antique	12 50	
1 font 48-pt. Latin Antique	7 70	
1 font 6-pt. Tudor Black	2 25	
1 font 8-pt. Tudor Black	2 75	
1 font 10-pt. Tudor Black	2 75	
1 font 18-pt. Tudor Black	3 40	
1 font 72-pt. De Vinne (caps only)	10 00	
1 font 24-pt. No. 1 Steelplate Script	4 00	
1 font 24-pt. No. 2 Steelplate Script (lower case)	2 00	
1 font 8-pt. piece fractions	3 60	
1 font 10-pt. piece fractions	2 80	
1 each brass braces, from 11 to 17, inclusive	2 25	
2 No. 2 lye brushes	80	

University Printing Office—Continued.

Bill of Palmer & Rey Type Foundry—Continued.		
1 small bellows	$0 90	
1 8″ reversible nickel composing stick	1 55	
1 tin reducing compound	50	
1 box boxwood quoins	75	
1 Reference Manual	50	
1 doz. yards pica reglet	35	
6 yards each 2 and 4 line reglet	60	
3 yards each 6 and 8 line reglet	42	
1 overlay knife	50	
		$98 37
1 rm. 28x42, S. S. & S. tint—Blake, Moffitt & Towne		5 60
1½ rm. 24x38, S. S. & S. tint; ½ rm. S. S. & S. tint—Blake, Moffitt & Towne		10 40
2 rms. 28 Ashland folio—Blake, Moffitt & Towne		7 28
2 rms. 24 Ashland folio—Blake, Moffitt & Towne		6 24
2 half-med. rollers, recast—E. J. Shattuck & Co.		2 00
2 quarter-med. rollers, recast—E. J. Shattuck & Co.		1 50
1 brayer, recast—E. J. Shattuck & Co.		50
3 eighth-med. rollers, recast—E. J. Shattuck & Co.		1 50
1 lb. fine black job ink—E. J. Shattuck & Co.		1 00
1 lb. black job ink—E. J. Shattuck & Co.		75
Binding 1,700 Freshman lists—J. B. McIntyre		1 50
840 record cards—Blake, Moffitt & Towne		22 60
Expressage—Patterson & Co.		2 65
1 rm. mourning note—Blake, Moffitt & Towne		3 00
250 envelopes—Blake, Moffitt & Towne		40
7 lbs. 8-pt. O. S. No. 8—Palmer & Rey Type Foundry		2 75
20,000 enrollment cards—Blake, Moffitt & Towne		25 64
6,000 registration cards—Blake, Moffitt & Towne		10 85
200 sheets 120 M. B., cut—Blake, Moffitt & Towne		8 00
2 rms. 24 Ashland folio—Blake, Moffitt & Towne		6 24
2 rms. 28 Ashland folio—Blake, Moffitt & Towne		7 28
2 rms. 28 Whiting folio—Blake, Moffitt & Towne		8 96
10,000 No. 6 Manilla envelopes—Blake, Moffitt & Towne		6 00
150 8½x15 covers—Blake, Moffitt & Towne		40
1½ lbs. bour. sorts—Palmer & Rey Type Foundry		60
Expressage—Patterson & Co.		2 00
1 lb. job ink—E. J. Shattuck & Co.		50
2 med.—E. J. Shattuck & Co.		1 00
1 lb. bond black—E. J. Shattuck & Co.		1 00
2 rms. 24x38, S. S. & C. tint, cut and trimmed—Blake, Moffitt & Towne		9 75
2 rms. 24 Ashland folio—Blake, Moffitt & Towne		6 24
2 rms. 28 Ashland folio—Blake, Moffitt & Towne		7 28
2 rms. 28 Whiting folio—Blake, Moffitt & Towne		8 96
2 rms. 24x38, 44-lb., folded, cut in half—Blake, Moffitt & Towne		6 00
1 rm. 24x36, 40-lb. No. 1 Manilla—Blake, Moffitt & Towne		2 40
5 lbs. cotton twine—Blake, Moffitt & Towne		85
1 rm. 20-lb. Japanese linen folio—Blake, Moffitt & Towne		5 04
1 rm. 24-lb. Japanese linen folio—Blake, Moffitt & Towne		6 05
100 sheets M. B., cut—Blake, Moffitt & Towne		4 50
Expressage—Wells, Fargo & Co.		25
Expressage—Patterson & Co.		1 50
Expressage—Patterson & Co.		75
Bill of Blake, Moffitt & Towne:		
3,000 sheets cream note	$19 50	
3,000 inside envelopes	28 50	
3,000 outside envelopes	10 80	
	$58 80	
Less 20%	11 76	
	$47 04	
1 rm. Parson's medium, cut	7 20	
		54 24
Expressage—Patterson & Co.		75
55 sheets Whiting folio, cut—Blake, Moffitt & Towne		40
3 rms. Vesta folio, cut—Blake, Moffitt & Towne		4 80
2 rms. 24x38 S. S. & C. tint—Blake, Moffitt & Towne		9 75
1 rm. 28x42 S. S. & C. tint—Blake, Moffitt & Towne		5 25
Expressage—Patterson & Co.		50
1 2-H.P. multipolar, shunt-wound motor, starting box, pulley, and belt tightener, 1,200 r. p. m.—Westinghouse Electric and Mfg. Co.		115 00
75 sheets 120 M. B. cream, cut—Blake, Moffitt & Towne		3 50
1 lb. bond black—E. J. Shattuck & Co.		1 00

University Printing Office—Continued.

1 lb. book black—E. J. Shattuck & Co.		$0 50
1 lye brush—E. J. Shattuck & Co.		40
3 eighth-med. rollers, recast—E. J. Shattuck & Co.		1 50
3 quarter-med. rollers, recast—E. J. Shattuck & Co.		2 25
1 brayer roller, recast—E. J. Shattuck & Co.		50
Expressage—Patterson & Co.		2 25
Salaries for the year ending June 30, 1896		1,560 00
		$2,159 43

UNIVERSITY SITE IMPROVEMENT.

Labor, month of June, 1895		$263 00
Repairing mower—Nelson & McLellan		1 00
Repairing wagon-brake—Nelson & McLellan		75
8 horseshoes—Nelson & McLellan		4 00
Labor, month of July		265 80
6 picks repaired—Nelson & McLellan		2 10
8 horseshoes—Nelson & McLellan		4 00
Labor, month of August, 1895		280 00
10 bbls. White's cement—Henry Cowell & Co.		34 00
Labor, month of September, 1895		254 00
1 ton rolled barley—Congdon & Co.		15 00
½ ton bran—Congdon & Co.		7 00
1 set best Concord harness—Frank C. Howe		40 00
Culvert across Oxford Street—C. A. Miller		904 00
Labor, month of October		276 00
Repairing four picks—Nelson & McLellan		3 00
8 horseshoes—Nelson & McLellan		4 00
6 Ames' shovels—A. Erlandsen		7 20
4 Phœnix Canariensis—California Nursery Co.		28 00
Labor, November, 1895		268 00
355 ft. 2″ drain tile—Gladding, McBean & Co.		7 10
Blacksmithing—Nelson & McLellan		7 50
Labor, December, 1895		253 00
Labor, January, 1896		268 00
6 blue prints of map of grounds—San Francisco Blue Print Co.		5 00
Blacksmithing—Nelson & McLellan		5 35
Labor, February, 1896		260 00
10,210 lbs. hay—George Mulholland		50 00
Blacksmithing—Nelson & McLellan		1 75
Making new road, etc., as follows:		
Expressage—Patterson & Co.	$4 50	
25 picks—Pierce Hardware Co.	17 70	
25 pick handles—Pierce Hardware Co.	5 83	
Expressage—Alex. Sharp	19 15	
Use of team and men, 4 days—J. J. Dunn	33 00	
1 crowbar—J. J. Dunn	1 45	
Labor, 28 days—John McCallum	72 25	
Labor and use of team, 2½ days—M. L. Gray	20 00	
Labor and use of team, 7 days—Robert J. Carter	23 50	
Labor and use of team, 4 days—E. J. Gordon	13 00	
Labor and use of team, 2½ days—J. N. Jacobson	10 00	
Labor and use of team, 2½ days—A. C. Jacobson	10 00	
Labor and use of team, 1½ days—J. C. Isherwood	6 00	
Labor and use of team, 5 days—R. Davis	20 00	
Labor and use of team, 2½ days—F. L. Manning	10 00	
Labor, 5 days—James Stutt	10 00	
Labor and use of team, 4 days—John Stutt	16 00	
Labor and use of team, 2 days—George Schmidt	17 00	
Labor and use of team, 4 days—R. Moore	16 00	
Hauling rock—R. Moore	16 00	
Labor, with team, 4 days—George Stutt	16 00	
Labor, with team, 3½ days—W. McGuire	14 00	
Labor, with team, 1½ days—George McClellan	6 00	
Lowering gas service, North Hall—Oakland Gas L. & H. Co.	10 50	
		387 88
6 garden hoes—A. Erlandsen		2 00
6 scythes—A. Erlandsen		3 75
Grading around North Hall		97 00
Labor, April, 1896		268 00
Blacksmithing—Nelson & McLellan		4 00
210 lbs. hay—George Mulholland		1 05
12½ lbs. orchard grass seed—Trumbull & Beebe		2 50
Finishing work around North Hall, filling in soil, guttering and grading walks, etc., and finishing road to Mechanics' building—George Stutt		145 00

University Site Improvement—Continued.

Plastering around North Hall, and concrete work—J. A. Marshall	$50 00
48″x300′ 2″ 16 galv. netting—California Wire Cloth Co.	13 20
2 lbs. 1″ 12 galv. staples—California Wire Cloth Co.	16
Hauling one load wheelbarrows to Golden Gate Park—People's Express and Transfer Co.	12 00
35 lbs. Australian rye seed—Trumbull & Beebe	3 50
5 lbs. orchard grass—Trumbull & Beebe	1 00
2 lbs. Kentucky blue grass—Trumbull & Beebe	50
20 lbs. Australian rye grass seed—Trumbull & Beebe	2 00
300 sq. ft. galv. wire netting and staples—A. Erlandsen	1 65
Blacksmithing—Nelson & McLellan	6 55
1 6x6x16 post and 1 bolster—Johnson & Cavan	2 50
24 pieces 2x4 8 ft. pine, sawed—Johnson & Cavan	9 00
2 lbs galv. staples—A. Erlandsen	25
Expressage—Patterson & Co.	1 00
Labor, month of May, 1896	270 00
	$5,071 04

PROPAGATING HOUSE.

Excavating—Joe McKeown		$6 00
Excavating—Wm. Walters		18 00
Excavating—Neal Kelley		38 00
1 gal. paint—S. Wakeham		1 75
20 pieces redwood, 1″x 24″x 12′—Henry W. Taylor		12 00
100 4″ drain tile—Gladden, McBean & Co.		4 00
180 ft. surfaced redwood—Pacific Lumber Co.	$4 50	
1 keg 10d wire nails—Pacific Lumber Co.	2 40	
	6 90	
Less 2%	14	
		6 76
624 ft. Oregon pine, S. 1 S.; 234 ft. Oregon pine, S. 1 S.; 80 ft. redwood—Pacific Lumber Co.		12 75
Labor		151 20
Services of architect—Clinton Day		408 28
76 lbs. galv. iron—J. J. Menges		4 00
Rivets—J. J. Menges		15
Labor—J. J. Menges		6 00
Constructing brick annex—Whitney & Mara		1,400 00
Labor		81 00
Labor		28 00
1 galv. steel sink—A. Erlandsen		3 00
1 pr. galv. brackets—A. Erlandsen		1 35
1 2″ galv. elbow—A. Erlandsen		35
20 ¾″ galv. elbows—A. Erlandsen		1 60
6 ¾″ tees—A. Erlandsen		60
3 ¾″ crosses—A. Erlandsen		35
2 ¾″ ells and bushings—A. Erlandsen		25
1 2″ nipple—A. Erlandsen		10
1 key fitted—A. Erlandsen		25
5 ¾″ galv. tees—A. Erlandsen		50
6 ¾″ caps—A. Erlandsen		25
6 ¾″ ells and bushings—A. Erlandsen		75
29½ lbs. sheet lead—A. Erlandsen		2 45
6 ells and bushings—A. Erlandsen		75
1 stopcock—A. Erlandsen		60
2 bushings—A. Erlandsen		10
1 hinge—A. Erlandsen		10
2 lengths stovepipe—A. Erlandsen		50
1 collar for stovepipe—A. Erlandsen		10
Labor		92 00
6 garden valves—A. Erlandsen		5 00
1 length 1″ pipe—Wm. Bullerman		1 70
3 1¼″ pipe couplings—Wm. Bullerman		45
1 reducer, 1¼″—Wm. Bullerman		15
4 galv. iron elbows—Wm. Bullerman		40
1 galv. tank—J. J. Menges		18 50
10 No. 1 vapor pans—J. Menges		45 00
		$2,355 04

ADMINISTRATION—FUEL.

136 tons, 2,140 lbs. Wellington coal—J. P. Taylor & Co.	$1,224 29
15 tons Welsh Anthracite coal—J. P. Taylor & Co.	164 85
Weighing above coal—L. N. Hagar	6 00
5 tons patent coke—J. P. Taylor & Co.	61 25
	$1.456 39

ADMINISTRATION—EQUIPMENT.

10 rolls toilet paper—John Maison		$0 50
14 lantern slides—Andrews & Lange		7 00
Labor, month of June		57 50
1 reversible blackboard—C. F. Weber & Co.		16 20
Labor, month of July		32 50
Lathing and plastering—Whitney & Mara		40 00
30 pieces corrugated rubber matting—Bowers Rubber Co.		39 75
1½ doz. perforated-seat chairs—California Furniture Mfg. Co.		12 35
2,811 cu. ft. gas—Oakland Gas L. & H. Co.		6 55
Labor, month of August		25 20
1 porcelain-lined sink—W. F. Wilson		9 45
1 bronze gas pendant, 2-light—Thos. Day & Co.		1 75
1 drop-light—Thos. Day & Co.		3 00
100 ft. base board—Johnson & Cavan		3 00
100 ft. base molding—Johnson & Cavan		2 50
100 ft. base shoe—Johnson & Cavan		1 00
40 ft. 6″ sewer pipe—Barker & Hunter Co.		4 20
6 6″ long tees—Barker & Hunter Co.		2 52
4 6″ ⅛ bends—Barker & Hunter Co.		1 40
58 tablet chairs—G. H. Fuller Desk Co.		135 72
1 6-tray cabinet, with outfit—Library Bureau		22 00
250 lbs. Pioneer lead—W. P. Fuller & Co.		15 00
1 doz. floor brushes—Levenson & Co.		27 00
1 doz. turkey dusters—Levenson & Co.		3 50
1 doz. sponges—Levenson & Co.		4 50
1 doz. papers tacks—Levenson & Co.		25
2 gross matches—Levenson & Co.		1 20
2 doz. brooms—L. Feldmann & Co.		6 00
1½ doz. hand brushes—L. Feldmann & Co.		8 25
1 doz. whisk brooms—L. Feldmann & Co.		1 50
1½ doz. chamois skins—L. Feldmann & Co.		6 75
1 doz. hand scrub brushes—L. Feldmann & Co.		1 50
57,560 cu. ft. gas—Oakland Gas L. & H. Co.		12 85
Labor, month of August		27 00
2 doz. Sterling erasers—Le Count Bros.		3 20
16 sacks sawdust—G. C. Pape		4 00
25 lbs. Castile soap—Lake & Co.		2 00
6 hand hatchets—Lake & Co.		2 25
1 box sand soap—Lake & Co.		1 20
3 doz. papers 4 and 6 oz. tacks—Lake & Co.		90
1 can matches—Lake & Co.		85
68 tablet chairs—G. H. Fuller Desk Co.		159 12
330 yds. cocoa matting—W. and J. Sloane & Co.		181 50
Labor, month of September		24 00
600 lbs. Prince's metallic paint—Yates & Co.	$9 00	
154 gals. raw linseed oil—Yates & Co.	77 00	
	$86 00	
Less 2%	1 72	
		84 28
12,000 cu. ft. gas—Oakland Gas L. & H. Co.		24 00
7,600 cu. ft. gas—Oakland Gas L. & H. Co.		17 10
Labor, month of October		27 00
Repairing plastering—Whitney & Mara		9 00
1 door and casing and fittings—Johnson & Cavan		18 00
6 McGriff fire-extinguishers and reporters—G. H. Tay Co.		66 00
12 3″ tubes for heater, and labor—T. N. Noble		25 00
Labor, month of November		26 00
48 pkgs. chloride lime—John Taylor & Co.		5 00
3 bdls. twine—Schmitt & Zehner		40
100 copies of Berkeleyan—Berkeleyan Publishing Co.		2 50
Washing towels—C. Howard		10 00
Washing towels—C. Howard		6 00
8 pkgs. toilet paper—John Maison		50
16,300 cu. ft. gas—Oakland Gas L. & H. Co.		32 60
13,000 cu. ft. gas—Oakland Gas L. & H. Co.		26 00
Labor, month of December		24 80
1 No. 2 "Cottage Home" stove—M. De La Montanya		8 00

Administration—Equipment—Continued.

29,000	Manilla envelopes—Blake, Moffitt & Towne		$90 00
	Labor, month of January, 1896		26 00
7	locks—C. L. Maxwell & Sons		3 50
	Washing towels—C. Howard		5 00
200	ft. 4″ soil pipe—Crane Co.		36 00
36	ft. 4″ hooks—Crane Co.		3 00
1	bale oakum—Crane Co.		3 25
	Labor, month of February		25 00
13,700	cu. ft. gas—Oakland Gas L. & H. Co.		27 40
11,000	cu. ft. gas—Oakland Gas L. & H. Co.		22 00
10	sacks sawdust—G. C. Pape		2 50
	Labor, month of March		26 00
10,000	cu. ft. gas—Oakland Gas L. & H. Co.		20 00
	Subscription to A B C Guide, 1896—Bishop's A B C Guide		5 00
13,200	cu. ft. gas—Oakland Gas L. & H. Co.		26 40
	Labor, month of April		26 00
5,500	cu. ft. gas—Oakland Gas L. & H. Co.		11 00
	Labor, month of May		26 00
			$1,714 64

ADMINISTRATION—REPAIRS.

25	doz. towels—C. Howard		$10 00
17½	doz. towels—C. Howard		7 00
	Labor, month of June		57 50
	Blue chalk—Schmitt & Zehner		25
	Carpet thread—M. C. Hamlin		10
	Carpet needles—A. Erlandsen		10
4	lock nuts—B. E. Underwood		25
600	lbs. sheet lead—G. H. Tay Co.		33 95
	Connections for automatic closet—Sanitary Plumbing Co.		14 00
540	ft. pine lumber—Pacific Lumber Co.		6 85
2½	M. fancy shingles—Pacific Lumber Co.		6 13
2,015	ft. surfaced redwood—Pacific Lumber Co.	$50 00	
1,008	ft. surfaced redwood—Pacific Lumber Co.	25 00	
41½	M. shingles—Pacific Lumber Co.	62 25	
28½	M. shingles—Pacific Lumber Co.	42 75	
10	M. fancy shingles—Pacific Lumber Co.	25 00	
1,010	ft. sugar pine—Pacific Lumber Co.	60 00	
		$265 00	
	Less 2%	5 30	
			259 70
	Labor—L. Mason		24 00
2,000	ft. redwood—Henry W. Taylor		28 80
1,348	ft. pine—Henry W. Taylor		16 98
500	ft. sugar pine—Henry W. Taylor		22 50
	Labor, month of July		97 00
24	bushings—Dunham, Carrigan & Hayden Co.		24
3	doz. stopcocks—Dunham, Carrigan & Hayden Co.		13 00
1	stovepipe holder, for bench—Dunham, Carrigan & Hayden Co.		3 35
5¼	lbs. block tin—Dunham, Carrigan & Hayden Co.		92
2	boxes IX Dean tin—Dunham, Carrigan & Hayden Co.		13 50
36	lock nuts—Dunham, Carrigan & Hayden Co.		71
30	gals. gasoline—Dunham, Carrigan & Hayden Co.		7 50
240	bushings—Miller, Sloss & Scott		2 44
144	galv. nipples—Miller, Sloss & Scott		3 24
2	12-lb. soldering coppers—Miller, Sloss & Scott		3 00
24	unions—Miller, Sloss & Scott		1 50
36	¾″ and 1″ garden valves—Miller, Sloss & Scott		13 08
½	ton Cumberland coal—Miller, Sloss & Scott		7 50
112	lbs. bicarb. soda—J. Caire Co.		3 30
10	lbs. sulph. acid—J. Caire Co.		2 37
	Labor, month of August		25 20
10	pkgs. lampblack—S. Wakeham		50
3	2″ bends—B. E. Underwood		75
3	2″ double hubs—B. E. Underwood		60
2	4″ double hubs—B. E. Underwood		50
5	ft. 2″ castiron—B. E. Underwood		65
5	gross plumbago washers—G. H. Tay Co.		5 00
2	doz. plumbago washers—G. H. Tay Co.		30
1	stovepipe former—G. H. Tay Co.		14 40
1	burning machine—G. H. Tay Co.		8 10
24	return bends, ¾″ and 1″—G. H. Tay Co.		1 37
1	pr. soldering coppers—G. H. Tay Co.		1 10

Administration—Repairs—Continued.

24 1¼″ plugs—G. H. Tay Co.	$0 48
12 2″ lock nuts—G. H. Tay Co.	43
24 ⅜″ and ¼″ bushings—G. H. Tay Co.	24
18 doz. assorted galv. nipples—G. H. Tay Co.	3 95
9 doz. assorted black nipples—G. H. Tay Co.	4 83
6 doz. assorted galv. elbows—G. H. Tay Co.	1 60
100 ft ⅛″ bronzed pipe—G. H. Tay Co.	3 75
100 ft. ¼″ bronzed pipe—G. H. Tay Co.	1 75
100 ft. ⅜″ bronzed pipe—G. H. Tay Co.	1 75
300 ft. 1″ galv. pipe—G. H. Tay Co.	16 50
100 ft. 1″ black pipe—G. H. Tay Co.	3 75
100 ft. ¾″ black pipe—G. H. Tay Co.	5 50
200 ft. 1½″ black pipe—G. H. Tay Co.	12 50
200 ft. ½″ black pipe—G. H. Tay Co.	4 50
150 ft. ½″ galv. pipe—G. H. Tay Co.	5 25
6 2″ gate valves—G. H. Tay Co.	13 50
6 1½″ gate valves—G. H. Tay Co.	9 00
6 1¼″ gate valves—G. H. Tay Co.	6 30
6 valves with floats—G. H. Tay Co.	10 50
2 doz. ½″ comp. bibbs—G. H. Tay Co.	5 94
1 doz. ¾″ comp. bibbs—G. H. Tay Co.	5 40
6 2″ black unions—G. H. Tay Co	1 20
24 1¼″ black unions—G. H. Tay Co.	2 76
24 1″ black unions—G. H. Tay Co.	2 04
12 1″ hose couplings—G. H. Tay Co.	1 10
12 1″ clamps—G. H. Tay Co.	50
Repairs to chemical engine—W. T. Y. Schenck	20 00
Repairs to Babcock extinguisher—W. T. Y. Schenck	15 00
4 charges for chemical engine—W. T. Y. Schenck	10 00
Labor—G. H. Brown	90 00
Labor, month of August	27 00
6 1½″ black tees—R. N. Wood	75
1 pr. B. and hangers—C. L. Maxwell & Sons	1 25
14 ft. track—C. L. Maxwell & Sons	1 40
1 pr. sash lifts—C. L. Maxwell & Sons	35
1 pr. B. D. hangers—C. L. Maxwell & Sons	1 25
8 ft. track—C. L. Maxwell & Sons	80
2 drawer pulls—C. L. Maxwell & Sons	65
1 Golden Gate valve—R. N. Wood	3 00
100 ft. picture molding—Johnson & Cavan	1 00
10 Yale key blanks—A. Erlandsen	85
Washing towels—C. Howard	6 00
12 pieces 4″ sewer pipe—Barker & Hunter Co. 2 4″ bends—Barker & Hunter Co. 1 4″ tee—Barker & Hunter Co.	2 35
17 lbs. 3d nails—Schmitt & Zehner	1 00
1 keg 3d wire nails—A. Erlandsen	4 20
Labor, month of September	24 00
6 1½″ fire gate valves, with cap—G. H. Tay Co.	16 17
6 1½″ street elbows—G. H. Tay Co.	80
Labor, month of October	27 00
6 Yale key blanks—C. L. Maxwell & Sons	75
Labor, month of November	26 00
4 key blanks—C. L. Maxwell & Sons	50
Labor, month of December	24 80
1 pr. butts—C. L. Maxwell & Sons	1 50
Labor, month of January, 1896	26 00
10 sacks sawdust—G. C. Pape	2 50
117 ft. pine lumber—Pacific Lumber Co.	1 90
Repairs to library clock—M. C. Kittredge	1 25
Examination of sewerage—C. E. Grunsky	37 50
Examination of sewerage—F. B. Thompson	2 50
2 lbs. ivory black—W. P. Fuller & Co.	70
3 6″ traps—Gladding, McBean & Co.	5 25
1 door astragal—Niehaus Bros. Co.	1 00
1 4″x 6″ tee—Gladding, McBean & Co.	70
2 4″ bends—Barker & Hunter Co.	50
Labor, month of February	25 00
40 ft. hose for fire extinguishers—New York Belting & Packing Co.	6 00
Picture wire—C. L. Maxwell & Sons	75
Labor, month of March	26 00
Repairing satchel—S. Taylor	15

Administration—Repairs—Continued.

3 qts. green paint—W. P. Fuller & Co.	$3 00
1 door lock—Central Hardware Co.	2 50
Labor, month of April	26 00
1 key blank—A. Erlandsen	10
Supplying clean towels—C. Howard	4 00
Carpenter work in gymnasium—G. H. Brown	7 50
2 4″ bends—Barker & Hunter Co.	50
Supplying clean towels—C. Howard	4 50
1 key—John Simon	25
3 4″ bends—Barker & Hunter Co.	75
1 piece gimp—Hulse, Bradford & Co.	60
2½ yds. felt—J. J. O'Brien & Co.	2 00
Washing towels—C. Howard	5 00
Labor, month of May	26 00
	$1,373 02

ADMINISTRATION—ADVERTISING AND PRINTING.

Printing 500 copies report of Academic Council—C. A. Murdock & Co.	$13 00
Printing 300 copies report of E. S. Holden—C. A. Murdock & Co.	8 00
Examination papers—C. A. Murdock & Co.	16 00
Advertising for proposals for painting buildings—	
San Francisco Bulletin	2 50
San Francisco Call	3 50
San Francisco Chronicle	3 50
San Francisco Examiner	3 50
San Francisco Report	2 50
San Francisco Post	3 00
Oakland Times	3 50
Oakland Tribune	2 10
Oakland Enquirer	1 75
50 circulars Hearst Scholarship—C. A. Murdock & Co.	1 50
70 examination cards—C. A. Murdock & Co.	1 50
Binding 1,000 pamphlets—J. B. McIntyre	3 50
10,000 examination blanks—Blake, Moffitt & Towne	40 00
Advertising for proposals for Cadet uniforms—	
San Francisco Chronicle	3 50
San Francisco Examiner	3 80
San Francisco Bulletin	2 50
San Francisco Call	3 50
San Francisco Post	1 80
Oakland Times	1 50
Oakland Enquirer	1 90
Oakland Tribune	2 10
75 Greek examination papers—J. S. Cushing & Co.	4 50
	$134 45

ADMINISTRATION—TELEGRAPHING AND EXPRESSAGE.

Exchange on Controller's warrants—Louis Sloss, Treasurer	$28 50
Telegraphing—Western Union Tel. Co.	2 00
Telegraphing—Western Union Tel. Co.	40
Expressage—Wells, Fargo & Co.	5 28
Expressage—Patterson & Co.	24 88
Exchange on Controller's warrants—Louis Sloss, Treasurer	55
Exchange on Eastern drafts—Louis Sloss, Treasurer	80
Fees on money orders—John McCarthy, P. M.	57
Rental of telephone, July and August—Sunset Tel. & Tel. Co.	15 60
Exchange on Controller's warrants—Louis Sloss, Treasurer	21 87
Expressage—Wells, Fargo & Co.	2 85
Expressage—Patterson & Co.	8 00
Expressage—Patterson & Co.	24 75
Fees on money orders—John McCarthy, P. M.	66
Expressage—Patterson & Co.	31 73
Expressage—Wells, Fargo & Co.	27 35
Exchange on Controller's warrants—Louis Sloss, Treasurer	1 51
Expressage—Louis Sloss, Treasurer	75
Rental of telephone, September—Sunset Tel. & Tel. Co.	8 70
Telegraphing—Western Union Tel. Co.	3 03
Fees on money orders—J. McCarthy, P. M.	31
Exchange on Eastern drafts—Louis Sloss, Treasurer	1 50
Telegraphing—Western Union Tel. Co.	2 00
Telegraphing—Western Union Tel. Co.	2 00
Telegraphing—Western Union Tel. Co.	2 36
Expressage—Wells, Fargo & Co.	75

Administration—Telegraphing and Expressage—Continued.

Rent of telephone, October—Sunset Tel. & Tel. Co.	$8 40
Fees on money orders—J. McCarthy, P. M.	15
Exchange on Eastern drafts—Louis Sloss, Treasurer	50
Expressage—Wells, Fargo & Co.	2 95
Expressage—Wells, Fargo & Co.	3 40
Expressage—Patterson & Co.	14 41
Expressage—Patterson & Co.	1 00
Rent of telephone, November—Sunset Tel. & Tel. Co.	7 65
Exchange on Eastern drafts—Louis Sloss, Treasurer	25
Fees on money orders—John McCarthy, P. M.	27
Exchange on Eastern drafts—Louis Sloss, Treasurer	25
Expressage—Wells, Fargo & Co.	25
Fees on money orders—John McCarthy, P. M.	03
Telegraphing—Western Union Tel. Co.	2 83
Expressage—Wells, Fargo & Co.	4 45
Rental of telephone, December—Sunset Tel. & Tel. Co.	7 50
Fees on money orders—John McCarthy, P. M.	1 32
Expressage—Wells, Fargo & Co.	2 30
Expressage—Patterson & Co.	16 53
Expressage—Patterson & Co.	2 58
Rental of telephone, January, 1896—Sunset Tel. & Tel. Co.	9 95
Exchange on Eastern drafts—Louis Sloss, Treasurer	60
Exchange on Eastern drafts—Louis Sloss, Treasurer	75
Exchange on Eastern drafts—Louis Sloss, Treasurer	1 00
Exchange on Controller's warrants—Louis Sloss, Treasurer	17 55
Expressage—Wells, Fargo & Co.	5 60
Expressage—Patterson & Co.	4 50
Rental of telephone, February, 1896—Sunset Tel. & Tel. Co.	8 75
Expressage—Wells, Fargo & Co.	60
Fees on money orders—John McCarthy, P. M.	51
Fees on money orders—John McCarthy, P. M.	26
Telegraphing—Western Union Tel. Co.	4 10
Exchange on Eastern drafts—Louis Sloss, Treasurer	25
Exchange on Controller's warrants—Louis Sloss, Treasurer	57 30
Expressage—Wells, Fargo & Co.	10 00
Expressage—Patterson & Co.	4 00
Exchange on Eastern drafts—Louis Sloss, Treasurer	2 25
Rental of telephone, March—Sunset Tel. & Tel. Co.	8 10
Fees on money orders—John McCarthy, P. M.	10
Fees on money orders—John McCarthy, P. M.	42
Telegraphing—Western Union Tel. Co.	5 91
Exchange on Eastern drafts—Louis Sloss, Treasurer	1 25
Expressage—Patterson & Co.	1 25
Fees on money orders—John McCarthy, P. M.	66
Expressage—Wells, Fargo & Co.	2 65
Rental of telephone, April—Sunset Tel. & Tel. Co.	9 75
Fees on money orders—John McCarthy, P. M.	18
Exchange on Eastern drafts—Louis Sloss, Treasurer	1 20
Exchange on Eastern drafts—Louis Sloss, Treasurer	1 00
Expressage—Wells, Fargo & Co.	5 11
Expressage—Patterson & Co.	21 00
Rental of telephone, May—Sunset Tel. & Tel. Co.	8 50
Exchange on Eastern drafts—Louis Sloss, Treasurer	25
Fees on money orders—John McCarthy, P. M.	16
Fees on money orders—John McCarthy, P. M.	29
Telegraphing—Western Union Tel. Co.	18 93
Exchange on Controller's warrants—Louis Sloss, Treasurer	37 50
Cartage and freight, Los Angeles—A. G. Van Gorden	2 19
Expressage—Wells, Fargo & Co.	1 35
Expressage—Wells, Fargo & Co.	3 50
Expressage—Wells, Fargo & Co.	8 20
Expressage—Patterson & Co.	10 50
Exchange on Eastern money orders—John McCarthy, P. M.	70
Exchange on Eastern money orders—Louis Sloss, Treasurer	25
Exchange on Eastern money orders—John McCarthy, P. M.	03
Exchange on Eastern money orders—John McCarthy, P. M.	58
Exchange on Eastern money orders—Louis Sloss, Treasurer	50
Exchange on Eastern money orders—Louis Sloss, Treasurer	25
Exchange on Eastern money orders—John McCarthy, P. M.	03
Telegrams—Western Union Tel. Co.	1 90
Express—Wells, Fargo & Co.	7 50
Telephone—Sunset Tel. & Tel. Co.	9 40
	$594 70

ADMINISTRATION—STATIONERY.

2	gross rubber bands—Cunningham, Curtiss & Welch	$1 80
2,000	envelopes—Blake, Moffitt & Towne	6 00
500	envelopes—Blake, Moffitt & Towne	50
150	mailing tubes—Cunningham, Curtiss & Welch	3 00
1,000	envelopes—Blake, Moffitt & Towne	3 50
2	student's deposit receipt books—Hicks-Judd Co.	9 00
1	qt. ink—McNutt, Kahn & Co.	60
12	qts. Barnes' ink—H. S. Crocker Co.	4 50
12	qts. Pomeroy mucilage—H. S. Crocker Co.	8 00
	A B C Guide, November, 1894, to November, 1895	5 00
½	doz. carbon paper—E. W. Hill	3 50
	Binding 1 book—J. B. McIntyre	2 25
5	rms. Westlock demy—Dutton & Partridge	20 40
12	copying books—Dutton & Partridge	15 00
11	student's deposit receipt books—Dutton & Partridge	49 50
250	mortgage blank notes—Hinton Printing Co.	2 50
½	doz. ribbons for typewriter—Scott & Bannan	4 50
1	shield for typewriter—Scott & Bannan	10
1	bottle of ink—Scott & Bannan	25
1	desk diary—Dutton & Partridge	1 25
	Binding 250 reports—J. B. McIntyre	1 50
1	student's deposit receipt book—Dutton & Partridge	4 50
	Binding 1,750 joint regulations—J. B. McIntyre	3 50
100	carbons—S. F. Typewriter Exchange	3 60
¼	rm. journal paper—Dutton & Partridge	1 50
1	bottle of oil—S. F. Typewriter Exchange	20
1	eraser—S. F. Typewriter Exchange	10
	Binding 1,700 Freshman lists—J. B. McIntyre	1 50
100	memo. pads—Blake, Moffitt & Towne	4 50
1	box of rubber bands—Brown & Power	15
	Stitching salary rolls—Hicks-Judd Co.	75
1	rm. onion-skin folio—Blake, Moffitt & Towne	4 85
1	knife eraser—Brown & Power	50
6	Globe transfer cases—Cunningham, Curtiss & Welch	2 10
6	Globe index cases—Cunningham, Curtiss & Welch	2 40
1	qt. mucilage—Cunningham, Curtiss & Welch	1 00
3	qts. ink—Cunningham, Curtiss & Welch	2 95
1	ruling pen—Cunningham, Curtiss & Welch	75
3	gross pens—Cunningham, Curtiss & Welch	1 75
250	mourning envelopes—Blake, Moffitt & Towne	1 50
1	doz. Cyclone files—Brown & Power	3 50
4	diaries—Brown & Power	2 00
1	ball twine—Brown & Power	10
1	box gold seals—C. G. Hardy	25
1	rm. onion-skin folio—Blake, Moffitt & Towne	4 95
400	gold seals—Brown & Power	1 00
2	check books—Hicks-Judd Co.	13 00
24	sets Treasurer's reports—Dutton & Partridge	6 50
12	check books, student's deposits—Dutton & Partridge	11 25
2	gross rubber bands—Dutton & Partridge	75
100	carbons—S. F. Typewriter Exchange	3 60
	Ruling blanks—Blake, Moffitt & Towne	75
250	Manilla envelopes—Blake, Moffitt & Towne	1 50
2	quires Manilla paper—Blake, Moffitt & Towne	80
1	ball twine—Blake, Moffitt & Towne	10
50	sheets blotting paper—Blake, Moffitt & Towne	1 50
100	sheets carbon paper—S. F. Typewriter Exchange	3 60
170	sheets onion-skin paper—Blake, Moffitt & Towne	1 80
6	memo. books—Payot, Upham & Co.	1 40
1	gross pens—Payot, Upham & Co.	75
1	journal—Payot, Upham & Co.	65
1	jar paste—Student's Coöp. Ass'n	15
3¼	doz. pencils—Cunningham, Curtiss & Welch	1 00
1	quire paper and envelopes—Hartwell, Mitchell & Willis	1 25
½	doz. Koh-Inor pencils—Sanborn, Vail & Co.	50
2,000	No. 1 flathead fasteners—Brown & Power	1 50
100	sheets cobweb carbon—Payot, Upham & Co.	4 35
2	Crocker-Langley Directories—H. S. Crocker Co.	10 00
		$259 25

ADMINISTRATION—POSTAGE.

Postage stamps—John McCarthy, P. M.	$200 00
Postal cards—John McCarthy, P. M.	2 00
Postage stamps—John McCarthy, P. M.	50 00
Postal cards—John McCarthy, P. M.	3 00
Postage stamps—John McCarthy, P. M.	50 00
Postage stamps—John McCarthy, P. M.	100 00
Postage stamps—John McCarthy, P. M.	100 00
Postal cards—John McCarthy, P. M.	2 00
Postage stamps—John McCarthy, P. M.	3 00
Postage stamps—John McCarthy, P. M.	46 50
Postage stamps—John McCarthy, P. M.	46 50
	$603 00

ADMINISTRATION—OFFICIAL AND LECTURING EXPENSES.

Traveling expenses—F. Slate	$54 80
Traveling expenses—A. B. Pierce	39 65
Traveling expenses—W. D. Armes	33 10
Traveling expenses—M. W. Haskell	11 40
Traveling expenses—E. R. Drew	14 50
Premium on Secretary's bond—Pacific Surety Co.	50 00
Premium on Assistant Secretary's bond—Pacific Surety Co.	50 00
Clerical work, Recorder's office—H. B. Torrey	50
Clerical work, Recorder's office—H. B. Torrey	75
Traveling expenses—L. D. Syle	1 40
Clerical work, Recorder's office—R. H. Sherman	12 20
Clerical work, Recorder's office—R. H. Sherman	11 90
Conducting entrance examinations—L. R. Hewitt	20 00
Clerical work, Recorder's office—C. H. Harwood	10 00
Clerical work, Recorder's office—C. H. Harwood	8 50
Clerical work, Recorder's office—W. H. Graves	2 50
Traveling expenses—D. W. Gilbert	6 15
Traveling expenses—J. H. C. Bonté	4 10
Notary fees—J. R. Little	50
Traveling expenses—D. W. Gilbert	3 10
Typewriting bonds of indemnity—H. C. Warren	1 50
Traveling expenses—W. C. Jones	100 00
Traveling expenses—D. W. Gilbert	3 40
Traveling expenses—J. H. C. Bonté	4 40
Traveling expenses—W. H. Phipps	1 15
Notary fees—J. R. Little	50
Clerical work—C. H. Harwood	7 00
Traveling expenses—E. B. Clapp	12 60
Rent of Style's Hall—A. S. Blake, Secretary	3 00
Clerical work—F. W. Koch	5 17
Clerical work—R. H. Sherman	34 25
Clerical work—J. A. Elston	12 42
Traveling expenses—A. F. Lange	11 80
Traveling expenses—D. W. Gilbert	4 70
Traveling expenses—D. W. Gilbert	3 45
Traveling expenses—J. H. C. Bonté	3 10
Recording Sutro deed—T. J. Glynn, Recorder	7 00
Traveling expenses—J. H. C. Bonté	7 00
Traveling expenses—D. W. Gilbert	4 15
Clerical work—R. A. McKenzie	2 75
Clerical work—J. A. Elston	13 12
Clerical work—Geo. Battelle	5 00
Clerical work—M. McKenzie	3 50
Clerical work—J. A. Elston	4 50
Clerical work—H. A. Overstreet	7 00
Traveling expenses—W. A. McKowen	10 40
Traveling expenses—D. W. Gilbert	4 60
Traveling expenses—J. H. C. Bonté	4 00
Typewriting 3 deeds—Misses Shephard	2 80
Typewriting 3 agreements—Misses Shephard	1 25
Traveling expenses—J. H. C. Bonté	4 20
Clerical work—L. S. Griswold	2 00
Traveling expenses—D. W. Gilbert	4 75
Notary fees—M. C. Hamlin	50
Clerical work—R. A. McKenzie	2 25
Clerical work—A. V. Stubenrauch	3 50
Clerical work—J. A. Elston	4 06
Clerical work—H. A. Overstreet	2 25
Clerical work—H. A. Overstreet	50

Administration—Official and Lecturing Expenses—Continued.

Traveling expenses—D. W. Gilbert	$6 70
Traveling expenses—E. B. Clapp	57 65
Traveling expenses—W. A. Merrill	99 20
Traveling expenses—C. C. Plehn	111 05
Traveling expenses—M. W. Haskell	32 40
Traveling expenses—D. W. Gilbert	5 70
Traveling expenses—J. H. C. Bonté	4 45
Traveling expenses—J. H. C. Bonté	4 25
Traveling expenses—A. F. Lange	33 75
Traveling expenses—F. Slate	135 35
Traveling expenses—C. B. Bradley	44 40
Traveling expenses—W. A. McKowen	7 80
Traveling expenses—D. W. Gilbert	8 00
Traveling expenses—I. Flagg	2 00
Traveling expenses—W. A. Merrill	33 15
Traveling expenses—C. C. Plehn	37 55
Traveling expenses—E. P. Lewis	6 30
Traveling expenses—E. R. Drew	44 90
Clerical work—H. A. Overstreet	1 40
Clerical work—J. A. Elston	2 68
Clerical work—H. A. Overstreet	1 25
Clerical work—G. D. Leslie	2 50
Traveling expenses—W. D. Armes	5 30
Traveling expenses—F. Slate	24 80
Traveling expenses—I. Stringham	107 60
Traveling expenses—C. M. Gayley	91 00
Traveling expenses—L. T. Hengstler	5 90
Traveling expenses—J. H. C. Bonté	5 10
Traveling expenses—J. H. C. Bonté	3 20
Traveling expenses—C. C. Plehn	27 40
Traveling expenses—C. B. Bradley	13 50
Traveling expenses—D. W. Gilbert	5 90
	$1.616 70

ADMINISTRATION—WATER.

Water, month of June, 1895—Alameda Water Co.	$225 00
Water, month of July, 1895—Alameda Water Co.	232 50
Contour map and survey of reservoir site—M. G. King	100 00
Water, month of August, 1895—Alameda Water Co.	232 50
Water, month of September, 1895—Alameda Water Co.	233 45
Water, month of October, 1895—Alameda Water Co.	232 50
Water, month of November, 1895—Alameda Water Co.	225 00
Water, month of December, 1895—Alameda Water Co.	232 50
Reservoir sites—Ann J. Stiles	3,800 00
Abstract of Stiles' lot—Stocker & Holland	5 00
Recording deed to Stiles' lot—Stocker & Holland	1 25
Water, month of January, 1896—Alameda Water Co.	232 50
Water, month of February, 1896—Alameda Water Co.	217 50
Water, month of March, 1896—Alameda Water Co.	232 50
Water, month of April, 1896—Alameda Water Co.	225 00
Taxes 1895-96, reservoir site—Town of Berkeley	12 67
Water, month of May, 1896—Alameda Water Co.	232 50
	$6,672 37

ADMINISTRATION—INSURANCE.

Insurance on N. K. Masten's property—J. C. Mitchell & Son	$19 15
Insurance on military goods, arms, etc.—J. C. Mitchell & Son	84 20
Insurance on military goods, arms, etc.—J. C. Mitchell & Son	20 40
Insurance on military goods, arms, etc.—New Zealand Ins. Co.	16 85
Insurance on military goods, arms, etc.—New Zealand Ins. Co.	21 65
	$162 25

ADMINISTRATION—COLLEGE CELEBRATIONS.

Engrossing diplomas—T. R. Southern	$8 00
150 diplomas—Schmidt Label & Litho. Co.	225 00
Engrossing diploma—Schmidt Label & Litho. Co.	50
9 diplomas—Schmidt Label & Litho. Co.	18 00
Engrossing 134 diplomas—T. R. Southern	67 00
	$318 50

ADMINISTRATION—PUBLICATIONS.

300 copies Miss Shinn's "Notes on the Development of a Child"—Berkeley Advocate	$37 00

RECAPITULATION.

RECEIPTS.

By cash on Controller's warrants	$112,543 56

DISBURSEMENTS.

To Department of Lick Observatory	$20,408 91
To Department of Mineralogy	692 94
To Department of Botany	388 07
To Department of Physics	967 33
To Department of Physical Culture	3,693 05
To College of Letters	25,687 72
To College of Social Sciences	23,908 81
To College of Natural Sciences	5,400 00
To Museum	1,290 61
To Library	5,578 34
To University Printing Office	2,159 43
To University site improvement	5,071 04
To propagating house	2,355 04
To fuel	1,456 39
To equipment	1,714 64
To repairs	1,373 02
To advertising and printing	134 45
To telegraphing and expressing	594 70
To stationery	259 25
To postage	603 00
To official and lecturing expenses	1,616 70
To water	6,672 37
To insurance	162 25
To College celebrations	318 50
To publications	37 00
Total	$112,543 56

UNIVERSITY OF CALIFORNIA—COLLEGE OF AGRICULTURE.
AGRICULTURAL EXPERIMENT STATION.

REPORT

OF THE

VITICULTURAL WORK

DURING THE SEASONS 1887-93,

WITH

DATA REGARDING THE VINTAGES OF 1894-95.

PART I. *a.* RED-WINE GRAPES (continued from Report of 1892).
b. WHITE-WINE GRAPES.
c. RAISIN AND TABLE GRAPES.
PART II. NOTES ON MISCELLANEOUS SUBJECTS.

BEING A PART OF THE REPORT OF THE REGENTS OF THE UNIVERSITY.

SACRAMENTO:
A. J. JOHNSTON, : : : : SUPERINTENDENT STATE PRINTING.
1896.

REPORT

OF THE

Professor of Agriculture and Director of the Experiment Station

TO THE

PRESIDENT OF THE UNIVERSITY.

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EXPERIMENT STATIONS OF THE UNIVERSITY OF CALIFORNIA,

1894-95.

CENTRAL STATION (Berkeley, Alameda County).

E. W. Hilgard, Ph.D., LL.D. (Professor of Agriculture), Director and Chemist.
E. J. Wickson, M.A. (Associate Professor of Agriculture, Horticulture, and Entomology), Superintendent of Agricultural Grounds.
R. H. Loughridge, Ph.D. (Assistant Professor), Agricultural Geologist and Agricultural Chemist.
C. W. Woodworth, M.S. (Assistant Professor), Entomologist.
W. A. Setchell, Ph.D. (Professor of Botany), Botanist.
M. E. Jaffa, Ph.B., M.S. (Assistant Professor of Agriculture), First Assistant Chemist in Agricultural Laboratory.
Arthur P. Hayne, Ph.B. (Instructor), Assistant in charge of Viticulture and Olive Culture.
Geo. E. Colby, Ph.B. (Instructor), Second Assistant Chemist in Viticultural Laboratory.
C. H. Shinn, A.B., Inspector of Stations.
F. T. Bioletti, B.S., Foreman of Viticultural Cellar.
Emil Kellner, Foreman of Station Grounds.
Wm. Winterhalter, Clerk to the Director.

SIERRA FOOTHILL CULTURE SUB-STATION (near Jackson, Amador County).

R. C. Rust, Patron; Jackson.
George Hansen, Foreman; Jackson.

SOUTHERN COAST RANGE CULTURE SUB-STATION (near Paso de Robles, San Luis Obispo County).

S. D. Ayres, Patron; Paso Robles.
A. V. Stubenrauch, Foreman; Paso Robles.

SAN JOAQUIN VALLEY CULTURE SUB-STATION (near Tulare City, Tulare County).

John Tuohy, Patron; Tulare City.
Julius Forrer, Foreman; Tulare City.

SOUTHERN CALIFORNIA CULTURE SUB-STATION (near Pomona, Los Angeles County).

C. F. Loop, Patron; Chino (appointed June, 1896).
J. W. Mills, Foreman; Pomona.

CHICO FORESTRY SUB-STATION (near Chico, Butte County).

R. F. Pennell, Patron; Chico.
A. B. Boland, Foreman; Chico.

SANTA MONICA FORESTRY SUB-STATION (near Santa Monica, Los Angeles Co.).

Roy Jones, Patron; Santa Monica.
J. H. Barber, Foreman; Santa Monica.

VITICULTURAL SUB-STATION (under private auspices).

East Side Santa Clara Valley Station; Mission San José, Alameda County. John Gallegos, Patron; Mission San José.

COURSES IN AGRICULTURE AT THE UNIVERSITY OF CALIFORNIA.*

AGRICULTURAL CHEMISTRY—

1. *General Course.* (*a*) Chemistry and Physics of Plants, three times a week during the first term. (*b*) Soils and theory of Culture, three times a week during the second term. Professor Hilgard and Assistant Professor Loughridge.
2. *Vinification.* Lectures twice a week during the first term, with practical cellar-work. Mr. Hayne and Mr. Bioletti.
3. *Agricultural and Viticultural Laboratory.* Twelve to fifteen hours a week during both terms. Assistant Professor Jaffa and Mr. Colby.

3*a*. *Analyses of Foods (human and animal) and Food Products.* Lecture once a week and six hours laboratory during second term. Assistant Professor Jaffa.

AGRICULTURE AND HORTICULTURE—

4. *General Course.* Three times a week during both terms. Associate Professor Wickson.
5. *Viticulture and Olive Culture.* Twice a week during the second term. Mr. Hayne.
6. *Special Courses* given as called for.

ENTOMOLOGY—

7. *Elementary and Economic Entomology.* (*a*) Lectures and laboratory work, twice a week during the first term. (*b*) Supplementary laboratory work, once a week during the first term. Assistant Professor Woodworth.
8. *Apiculture.* (*a*) Lectures, laboratory, and apiary work, twice a week during the second term. (*b*) Supplementary laboratory and apiary work, once a week during the second term. Assistant Professor Woodworth.
9. *Parasitic Plant Diseases.* Lectures twice a week during the first term. Assistant Professor Woodworth.
10. *Systematic Entomology.* Lectures three times a week during the second term Assistant Professor Woodworth.
11. *Structural Entomology.* Lectures three times a week during second term. Courses 10 and 11 are given in alternate years. Assistant Professor Woodworth.
12. *Entomological Laboratory.* Two or three times a week throughout the year. This course can only be taken with or after Courses 9, 10, or 11. Assistant Professor Woodworth.

AGRICULTURAL SEMINARY—

13. Elementary course for study of current agricultural literature, once a week during both terms. Associate Professor Wickson and other Instructors.

PRACTICAL WORK AT CELLARS AND VINEYARDS—

Students who have taken the course in viticulture can avail themselves of arrangements made with the best wine-makers and merchants for special opportunities to pursue, under the auspices of the University, such lines of work as will familiarize them with vinification and viticulture as practiced at large establishments in the city or country. Students showing special aptitude are enabled to earn good wages from the first; others merely work for their board. After working under University auspices at one or more establishments they are assisted in the pursuit of further information at the viticultural laboratory as opportunity offers.

---

*In addition to the general requirements in mathematics, literature, languages, and general sciences; for detailed description of which see the General University Register.

The regular course leading to a degree requires four years, and is intended to turn out agricultural *experts.* Students not expecting to graduate can enter for shorter courses as "*Specials,*" to obtain such instruction as they may desire.

LETTER OF TRANSMITTAL.

President MARTIN KELLOGG:

I transmit herewith the report of viticultural work done since the last report was issued, up to and including the vintage of 1895, so far as the latter can at present be usefully reported upon; including, also, a summary report on the white-wine grapes under cultivation in California, and their wine-making qualities; being the continuation and conclusion of the report already published in 1892, on the red-wine grapes grown in the State.

The publication of this report has been purposely delayed, for the reason that the depression of the wine industry in the State, and the consequent lack of interest on the part of grape-growers, seemed to render such publication inexpedient for the time. Now that that industry is again becoming more profitable, and is likely to be placed upon a more rational basis than has been the case heretofore, it seems proper to place before those interested all the facts and results which may conduce to a better understanding both of the methods of wine-making, and of the materials employed therein. This seems the more appropriate since, by an Act passed at the last session of the Legislature, the technical work of the State Viticultural Commission was transferred to the College of Agriculture; thereby materially changing and enlarging the scope of the work to be prosecuted hereafter. Up to the time when this Act, and the appropriation accompanying it, became effective, the viticultural work of this department was necessarily almost wholly confined to the laboratory and office, as there were no funds available for traveling, and for field and winery experiments. Although the appropriation accompanying the Act of transfer is quite small (being only one fourth to one fifth of the amount annually expended by the late Viticultural Commission), it permits of sufficient expansion to change materially the scope of the work; and for this reason alone it seems proper to make a final report upon what was done on the old plan. That work has now progressed so far as to form a solid and definite basis of facts for guidance in the preparation of the several classes and grades of wines, by ascertaining experimentally, as well as chemically, the peculiarities of each variety of grapes cultivated on a commercial scale within the State. It is merely a question of time when, instead of the confusion thus far prevailing in the classification of California wines, conformity to the commercial standards recognized all over the world will be established. That, in order that this may be accomplished, the investigation of the fundamental qualities (including the chemical composition) of each variety of grapes is a prerequisite, hardly requires discussion.

It is high time that the haphazard methods even yet so commonly pursued in this State, should be discarded, and that the experience had, whether in the winery or in the laboratory, should be gathered into a definite form, as a guide to the rational wine-maker; so that hereafter California wines may appear on the world's market under their own labels, instead of being, as has heretofore been too largely the case, disguised under foreign ones, when of good quality; while the poorer qualities were sure to be placed upon the market with the true statement of their California origin. California wine-makers must now avail themselves of the rapid and important progress made in Europe, in the preparation of the best wines possible from a given material. They must, above all, avail themselves of what experience has been had in climates similar to ours, instead of attempting each one to pursue the method of his own country, no matter how different in climatic and soil conditions. It is high time that the pernicious axiom once promulgated to the public, that "any fool can make wine," should be discarded by the viticulturist for the conviction that wine-making is a technical branch requiring special knowledge of no mean order, particularly when the industry is pursued under new conditions, such as prevail in California; and that while the experience of their forefathers has enabled European peasant wine-makers to produce good wines by following a definite procedure in certain localities, it will not do for us to blindly follow their lead. As a matter of fact, the introduction of scientific methods in European wine-making has increased enormously the amount of good wines now available in the world's market; and if we want to compete with these, it will be necessary to avail ourselves of the same progressive methods.

A very notable improvement in the average quality of our wines has occurred within the last five or six years, and the high excellence of the product obtained in so many cases renders any further continuance of slipshod methods inexcusable. What has been done once can be done again; and, with the organization of grape-growers and wine-makers now happily effected, it is reasonably to be expected that pecuniary reward will follow the application of rational principles in wine-making. In that respect, the chemical work at this station has been very instructive, as will be seen from inspection of the tables. The same varieties in different localities, such as Mission San José on one hand and Tulare on the other, show so widely different composition as to render the same variety wholly unadapted to one place while eminently fitted for the other. It is now generally understood that the same grape-variety grown in hot southern localities increases in sugar and loses in acid, as compared with a northern one; but the *extent* to which this occurs varies exceedingly with different grapes. In some the variation is very slight; while in the case of others the deterioration of wine-making qualities becomes such as to wholly throw out of consideration some of the grapes most highly favored elsewhere. On the other hand, some varieties of which it was fully expected that they would prove deficient in wine-making qualities in the southern localities, have on the contrary proved remarkably successful. And this occurred with some varieties from which such behavior was wholly unexpected. It will therefore well repay the intelligent wine-maker who desires to plant a vineyard, or to graft over unsatisfactory vines, to study these results carefully.

Respectfully,

E. W. HILGARD,
Director.

THE COMPOSITION AND CLASSIFICATION OF GRAPES, MUSTS, AND WINES.

By E. W. HILGARD.

The report herewith submitted to the public, and more especially to the grape-growers and wine-makers of the State, may be considered as marking the termination, for the present, of systematic investigation of grape-varieties with respect to their composition and general wine-making qualities in the different regions of the State. The method and final object of this work is stated in former reports, but it seems not unnecessary to re-introduce the main portion of that statement by way of introduction and explanation:

> The plan adopted in this matter is in conformity with my view, shared by the best vintners in the State: that among the first necessities of the present situation of California wines in the world's market, is the establishment of more definite qualities and brands, resulting from a definite knowledge of the qualities of each of the prominent grape-varieties, and of their influence upon the kind and quality of the wine, in blending before, or, as the case may be, after fermentation; of the treatment required by each in the cellar, during the time of ripening; and finally, of the differences caused by difference of location, climate, etc., as well as by different treatment of the wines themselves.
>
> To this end, a definite knowledge of the character and special wine-making qualities of each kind of grape serving in the preparation of wine, is indispensable. In the wine-producing countries of Europe this knowledge has been acquired by long experience; and chemical investigation has subsequently in a great measure ascertained the natural conditions upon which the attainment of certain results in wine-making depends. The principles thus evolved can be applied to new conditions, such as those existing in California, and thus save to a great extent the laborious and costly experimenting which has been gone through heretofore, by formulating into generally intelligible rules the knowledge which otherwise usually remains the trade secret of a few experts.
>
> The first step to such knowledge is to obtain a definite idea of the material to be treated; and, curiously enough, however numerous are the analyses of ready-made European wines already on record, there are comparatively few cases in which the must from which they were produced was also investigated in so definite a manner as to lead to broad generalizations. Clearly, what is needed is that first the must, and then the corresponding wine of the more important grape-varieties, should be made the subject of detailed investigation, and that the wine should have been produced from the must under definite, or definitely varied conditions, with absolute certainty of the purity of materials, as well as of the precise manner of operating in each case. This cannot, as a rule, be depended upon in large wineries, where the exigencies of the supply, pressure of work and weather, the necessary employment of raw hands, and above all, the necessity of yielding to financial considerations, impose limitations and uncertainties that can but rarely be controlled at will. When this *can* be done, the large-scale experiments are of course by far the more decisive and cogent, and of the greatest practical value.
>
> In an experimental laboratory, the quantities operated upon are of necessity relatively small; and it is highly important that allowance be made for this circumstance, as well as for other points in which the "wholesale" practice must always differ from the small-scale one. For instance: the management of the temperature of the fermenting-room is easier in a large winery properly constructed than in a small experimental room and with small quantities of must, which are very quickly affected by changes of temperature such as would have remained unnoticed and without influence upon the great masses in the winery. This difficulty is very apparent in the record of the course of temperatures in fermentation.
>
> Nevertheless, we are thus enabled to obtain a very close estimate of the results obtainable from a given variety on the large scale, and of the part that each will play when blended either before or after fermentation. Few grape-varieties will, like the peerless Riesling, by themselves produce the best possible product. The art and science of blending is scarcely second in importance to the possession of good raw materials, soils, and climates; and while its last refinements depend upon a corresponding refinement of indi-

vidual taste and judgment, there is a large part of it that can be intelligibly codified, thus preventing a waste of good materials upon unmerchantable wines.

Even the most cursory consideration, however, shows that this cannot be the work of one or of even a few years; but, like all other agricultural experiences and experiments, must be extensively repeated in order to become the basis of general practice. The same grape-varieties grown in different localities and in different years will differ materially in their composition; and it is only by extended comparisons of these through a number of years that the accidentals can be definitely segregated from the essentials. Hasty generalizations, based upon limited experience, are the bane of all experimental work, especially in agriculture.

It should be fully understood and remembered that while peculiarities and defects shown by analysis are perfectly definite indications as to the conditions that *must* be fulfilled in a successful blend, yet analysis cannot as yet take cognizance of the delicate and almost intangible flavors or "bouquets," which must likewise be made to harmonize, in order to satisfy a cultivated palate. To that extent the determination of the proper blends must always remain with the expert wine-taster; but the work of the latter is immensely facilitated by being informed, through the analysis, of the prominent chemical peculiarities, which in any case must be taken into consideration, and which ordinarily are left to laborious and more or less blind guessing or experimenting.

To this method it has been somewhat captiously objected that, as the chemical composition is not the determining factor of the commercial value of wine, the chemical analysis of musts and wines cannot serve as a clew to the quality to be obtained. It has also been said that wines produced on the small experimental scale, which is the only one possible with the means at our command, are incapable of furnishing a definite clew to the results of vinification on the large scale.

These objections, however, are wholly untenable; they would, if correct, prove the inutility of laboratory work in all the great achievements of industrial progress upon which our modern life is based.

As a matter of fact, for the first six months there is practically *no* difference between wines made *by the same method and with the same care*, in large and small quantities. It is at that age that wines are mostly sold by the producer to the dealer. After that time the development of the wines in the small package is much more rapid, and therefore somewhat different from that of the large one; the small package is also more difficult to handle and care for, and in a *winery* will usually soon pass beyond control. In an experimental cellar, where special and close supervision is given, a closer approximation to large-scale results is possible, and as our record abundantly shows, wines can there be carried to maturity, and their essential general qualities satisfactorily observed. When a good, mature wine has been made on the small scale, it is indisputable that the same can be done in the winery, and probably with greater ease. If, on the other hand, the result should be unsatisfactory, the nature of the particular difficulties in the way of success can be determined and verified, so as to forewarn the large-scale producer of their nature, and suggest the precautions to be used in avoiding them.

It is idle to pretend that such results are of no practical value. They have been again and again verified afterward in winery practice; and but for them, we would still be in dense ignorance of the essential features of most of the grape-varieties now growing in the State, when grown in different climatic regions. Moreover, of a large number of varieties here reported upon, only small experimental quantities were and still are available; so that their treatment on a small and inexpensive scale was the only possible mode of obtaining *any* information regarding them. To wait until some one should think of cultivating and testing them on the large scale would be to omit to do precisely that for which experiment stations have been established the world over; namely, to obtain probable indications of what are *likely* to be the results of large-scale practice, so as to prevent the useless expenditure of labor and money upon costly large-scale trials at haphazard.

As a *reductio ad absurdum*, it has been proposed to establish, on the part of the State, a large experimental vineyard and winery, where such experiments could be made on a "practical" scale. Aside from the enormous expense of creating, maintaining, and properly working even *one* such establishment, and the rather unsatisfactory experience had with much less difficult and complex work undertaken at State expense, it is abundantly obvious that unless several of them were created, or else the grapes were shipped by the carload to great distances from the extreme ends of the State, only a very limited region could be benefited by the enterprise, which would quickly collapse of its own cumbrous weight. No other grape-growing country has thought it necessary to burden the public purse with any such extravagant arrangement.

As to the cogency of chemical work: It is perfectly understood that certain conditions of chemical compositions *must* be fulfilled to render possible the production of certain kinds of wine at all; and while the exact quality and kind of the aroma to be produced cannot be thus foretold, it is absolutely certain that in the *absence* of such chemical conditions certain desirable qualities will invariably be found lacking. Thus, it is universally understood that a certain minimum of acidity is required in a must in order to obtain a sound and complete fermentation, and that a certain class of aromas are indispensably dependent upon the presence of such acids in adequate amounts. Hence the quantitative determination of these acids alone is invaluable in forming a judgment of the best use to be made of different kinds of grapes, whether in blending in the vat, or in blending the wine after fermentation. This is so true that when the acids are known to be insufficient they are often added at heavy expense by the purchase of tartaric acid, in order to secure a good fermentation and a high flavor. Even unripe grapes are sometimes added to the fermenting-vat for the purpose of supplying this acid without such expense.

It has also been alleged that the taste of expert tasters is a better guide to the acidity and astringency in wine than is chemical analysis. But in the presence of sugar or much tannin, the best expert taster will often find himself completely at a loss as regards the real amount of acid present, and he will make grievous mistakes in blending, whether before or after fermentation. Yet this proper proportion in blending in the vat frequently cannot be remedied to advantage after the wine is made. In the best case, the blender will be wasting time by laborious and random trial of various blends, to which a knowledge of the chemical composition would have given him a direct clew.

In the case of Clarets, their distinctive quality of allowing a considerable dilution with water without disturbing the proper proportion of the tannin and acids, rests wholly upon the fact that acid and tannin must stand to each other within definite limits of proportion, beyond which no Claret capable of standing the dilution test can be produced. Other wines, such as Burgundies, are never expected to be diluted with water; a very slight addition of such will surely destroy its character, as the apparent proportion between acid and tannin changes completely after such a wine is diluted. This quality also, then, is entirely dependent upon certain amounts of, and proportions between, acid and tannin, of which by chemical analysis we readily ascertain the existence or absence, whether in the grape or in the wine.

So, also, the qualities of "body," smoothness, and others, are largely dependent upon certain definitely ascertainable chemical data. The keeping qualities, likewise, are largely conditioned upon chemically ascertainable conditions. It is thus obvious that in a new country like California, in which the specific wine-making qualities of most of the various grapes grown in the State are as yet unknown quantities, the determination of their chemical peculiarities can render the most essential practical service to the wine-maker, whether in determining the best adaptation of varieties already planted, or in the selection of those best adapted to his locality and purposes.

The time will doubtless come when some special type or types of wine, resulting from peculiar climatic conditions, and the multiplicity of grape types introduced, will be developed in California. But the time for this has hardly come as yet; the most pressing need now is to find a market for our wines, and to that end the most direct path lies through measurable conformity to established commercial types and qualities; based, not upon mere nominal imitation of the blends of varieties thus used in Europe, but upon an actual knowledge of what our climatic and soil conditions have made of those varieties, and how we can treat and blend them in order to conform to the established tastes of the world.

CLASSIFICATION AND TYPES.

Classification of Wines.—The commercially established classification of wines, as it exists in the European wine-making countries, must for the present at least, naturally guide California wine-producers also, as far as possible, if they desire their share of the world's commerce. To some extent it has been done in a tentative way heretofore; we hear of Bordeaux or Claret, of Burgundy, Riesling, and Sauterne, as well as of Port, Sherry, and Madeira. But if we examine somewhat critically, or sometimes even quite superficially, a great many of the wines sold under certain denominations, we find striking and almost ludicrous discrepancies between their character and that which is understood by the same name in Europe. One designation which has been used with reasonable correctness is Claret or Bordeaux wine; these are dry wines of rather high or medium acidity and tannin contents, which at the same time *will bear dilution with water* without disturbing the palatable ratio between acid and tannin. But when we come to the various California wines sold under the name of Burgundy, we find included therein such an utterly discrepant medley of different types, that the only possible definition at the present time seems to be "a red wine that will not bear dilution with water without losing its character"; and even this distinction is far from being always maintained. Thus, one sample sent to this laboratory for examination under the name of Burgundy, showed not less than 8 promille of acid and 4½ promille of tannin; it was, therefore, a highly acid and tannic wine, unsuitable for direct consumption, and belonging most decidedly to the Claret type of blending material. Then, at the same time, other samples come to us, approaching much more nearly the true character of Burgundy wines; namely, having a low proportion of acid and very light tannin, and incapable of resisting even a slight dilution with water without losing their zest, and of a red or orange-red tint of very slight intensity. Such wines approach more closely the type of the French Burgundy; but how can it be expected that any one ordering a "Burgundy" wine, and expecting something similar to what is so called in French commerce, should be satisfied with a wine of high acidity and astringency, such as that mentioned above, which stands on the opposite end of the scale from the true Burgundies? The term is now widely used in this indefinite manner by growers and wine-merchants; but it seems of the highest importance that this mischievous misnomer should be discontinued as early as possible, by all who are interested in the good name in the commercial world, of California wines and wine-makers. No doubt the failure of the characteristic grape of Burgundy (the Pinot) to yield satisfactory crops and wine-making results in California, is responsible to a large extent for the confusion that has arisen in regard to the Burgundy type. As the Pinots are characterized by low acid, high sugar, and low color, other grapes possessing similar characteristics, and sometimes grapes not possessing any of them, were included within the group; and thus we find in different vineyards seven or eight varieties growing under the name of Burgundy. Such varieties are Chauché noir, Trousseau, Robin noir, Cinsaut, and several others; the visible characters of these grapes differ so widely from that of the Pinot group proper that it was evidently only the superficial similarity of the *wine* that has led to the misnomer. Unfortunately, the designation has been extended to one important grape, the so-called Crabb's Burgundy, now recognized as being identical with the Refosco of northern Italy; an excellent wine-making grape, approaching the Claret type, and especially useful in that connection. This is probably the most mischievous of the misnomers of Californian nomenclature, as it causes the largest disappointment to those who order California wines for their own consumption, under the supposition that the type is measurably true to the French one.

Of other commercial classes of wine, the Sauterne type is probably the one that has adhered most closely to the typical grape product of the Gironde; largely because, naturally, the California climate is better adapted to the production of the Sauterne than of the Rhenish type of white wines. The latter class is here largely comprehended under the term "Riesling," which has been indifferently applied to almost any white wine, of whatever flavor, that possesses a high degree of acid, no matter how heavy its body, and how unlike the true Rhenish type.

Now, it is useless to attempt to ignore the fact that the California climate is particularly ill adapted to the reproduction of the kinds of wine which are produced near the northern limit of wine production in Europe. It is only in locations close to the coast, and protected from the warm rays of the summer sun, that anything similar to the true Rhenish type can be expected to be produced in California; it is idle to expect that anything properly resembling the Rhenish wines can be produced in the hot *valleys* of the Coast Range, from the same grape that produces it in the old country. The hill country of the coast ranges has done much better. It was at one time thought that the higher locations in the Sierra Nevada foothills also might produce such wine; but experience has shown that, on the contrary, the western Sierra slope is more specially adapted to wines corresponding to those of the south of Europe than to anything resembling those of the Rhine and the Moselle. In order that these types may be imitated with any degree of accuracy, new blends must be devised and different characters of grapes used, specially qualified *here* to form such wines, to which the flavor of the noble Riesling is imparted by an adequate blend. The use of the so-called Burger in this connection has, in the Napa, Sonoma, and Santa Clara valleys, proven measurably satisfactory; but there are other varieties, as yet but little cultivated, which will render similar and perhaps even superior services.

In European publications and ampelographies, the grape-varieties, if classified at all, are usually arranged in accordance with their botanical resemblances. But for practical purposes it is much better and more rational to classify them, as nearly as may be, *according to their wine-making qualities*, and their practical value for the grape-grower and wine-maker. That such a classification can, even in the best case, be only approximately correct and consistent, is a matter of course; not only because, according to the method of treatment, different wines may be made from the same grape in the same locality, but more usually because the same grape in a *different* locality may, in its wine-making qualities, belong to a totally different class. Thus the Carignane forms an acceptable material as a Claret grape in the Santa Clara Valley and other northern portions of the State; while at Fresno and southward, the character of the Carignane is wholly changed, as it loses both color and acid and can only serve as a blend with other grapes of the Southern French type. The classification given below can, therefore, be considered only as approximate, as it must, in most cases, be materially modified according to the location in which the grape is grown.

Among the white grapes the "Burger"* is a notable example of a totally changed type when grown farther southward; for at Fresno its wine assumes much more nearly the character of a Sauterne, so that no one conversant with the wines made by this grape in the Napa and Sonoma valleys would ever suspect that it was the same variety that produces good dry white wines in the Fresno and Tulare regions. The Burger certainly belongs to the southern regions of Europe, and seems to be at its best in the warm valleys of the interior of the State. The Zinfandel also shows a remarkable change from Napa to Fresno, as is shown in the following little table:

	Alcohol.	Acid.	Tannin.	Body.
Zinfandel, second crop; average of northern localities	10.6	.70	.060	2.4
Zinfandel, second crop; average of Fresno	12.5	.55	.255	3.0

The Fresno second crop is almost precisely of the same composition as the first crop at the north, and makes a fairly good dry wine; while the Fresno first crop makes an inferior product, mostly only fit for the still.

Many similar examples might be given; but this may suffice to show the necessity of *testing one and the same grape in different localities* before we can fully recognize its qualities for wine-making purposes. These examples emphasize strongly the need of experimental stations in the different portions of the State, where such experimental growths can be made systematically, and independently of local private interests that might be involved in the results; which will obviate the need of costly experimentation by growers themselves, by informing them beforehand how best to attain the end they may have in view.

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* The true Burger of Germany is a wholly different grape.

Enumeration and Definition of Types.—Below is given a summary characterization of the chief types of commercial wines, with a view of the composition of commercial samples of the same, from European analyses; together with a list of the chief grape-varieties producing them, and a brief discussion of the differences observed in the same grapes and types in California, in our investigations, as well as by intelligent growers. It is one of the objects of this presentation of the subject in condensed and systematic form, to bring out the experience of growers in different portions of the State with respect to the nature of the grapes and wines in their districts. It is fully expected that some will disagree with the classification here given, in accordance with their local experience; and all such facts and data will be welcomed as an addition to the stock of observation yet required to place the production of California wines upon a thoroughly rational basis.

In the list of principal varieties under each type, those which in some localities have shown qualities that would entitle them to a place in another type, are indicated by italics.

RED-WINE TYPES.

Bordeaux or Claret Type.

Characteristics.—Medium alcohol, acid, tannin, and body; good, violet-red color; fresh taste, and full vinous flavor.

Principal Varieties.—Cabernet Sauvignon, Cabernet Franc, Verdot, Merlot, Malbeck, Teinturier, Gamai Teinturier, Charbono, *Tannat*, *St. Macaire.*

Composition. (According to the analyses of European commercial Medocs.)

	Alcohol by Volume.	Acid as Tartaric.	Tannin.	Body.
Maximum	11.5%	.70%	.200%	2.7%
Minimum	8.5	.45	.150	2.0
Average	10.5	.58	.175	2.3

Our California wines, made from the several Medoc or Bordeaux red-wine varieties, differ notably in composition from the average given above. While the acid content is nearly the same as in French wines, these are almost, without exception, heavier in alcohol and body. The most marked difference, however, is in the tannin, which is generally double, and often three times as high in the California as in the commercial French wines of this type. This does not necessarily mean that so great a change has been wrought in the nature of the grape, but more probably that the French wine-makers and wine-blenders adapt the composition to the tastes of their countrymen, and of the world at large.

The St. Macaire is placed here because of its origin in the Bordeaux district, and of its being used as a blend with Medoc wines. The character of its wine, however, would, in most cases, place it by the side of the Petit Bouschet in the Southern French type.

Rhenish Type—Red.

Characteristics.—Very nearly related to the Bordeaux type as regards the high-class wines, especially the Affenthaler. The common red wines are mostly quite light-colored.

Principal Varieties.—Affenthaler, Arbst, Blauer Burgunder.*

Composition. (According to König, of Germany.)

	Alcohol by Volume.	Acid as Tartaric.	Tannin.	Body.
Common wines—				
Maximum	11.00%	.70%	.250%	3.0%
Minimum	8.00	.40	.100	2.4
Average	9.70	.53	.175	2.7
Auslese wines—				
Maximum	14.00	.66	.250	4.0
Minimum	10.00	.43	.100	2.4
Average	12.50	.50	.158	3.0

The Affenthaler has in California given wines resembling in composition the most prized red wines of Germany. They have, however, more tannin than the commercial wines, and do not retain a remnant of sugar, which is often found in the German *auslese* wines to the extent of 0.25% to 0.50%; being then made from overripe, selected berries. Common red wines of Germany are largely made from the Frankenthaler or Trollinger (Black Hamburg) in conjunction with Arbst, Blauer Burgunder, and others, often blended with whites, and therefore quite light-colored.

Burgundy Type.

Characteristics.—Alcohol, body, and acid medium; astringency low; color light and tending to the orange-reds; very smooth, agreeable wines, without special aroma, but developing a fine bouquet with age.

Principal Varieties.—Pinot noir (Blauer Burgunder), Pinot de Pernand, Meunier, Gamai noir.

The Pinots in California have almost uniformly produced wines heavier in alcohol, tannin, and body, and lower in acid, than the ordinary commercial wines of the Côte d'Or. The Pinot wines of the Burgundy district vary considerably in alcoholic contents, however, according to season and location. The best have on the average 11% to 12% of alcohol by volume, though in certain years wines with 13% to 14% are produced. The wines of the plains, made principally from the Gamai noir, are much lighter in alcohol, ranging down from 11% to 8%, and sometimes lower. The average composition of Burgundy wines, according to König, Bedel, and others, is about 10.3% of alcohol, 0.6% of acid, and 2.4% of body; tannin not determined. This average doubtless includes wines both of the "Côtes" and of the plains; those of the hills having a heavy body and high alcohol. The Burgundies depend more on their peculiar smoothness, flavor, bouquet, and appearance for their distinctive character than on their alcoholic contents, which is a very variable quantity. Unlike the Bordeaux or Claret wines, dilution with even a little water destroys their zest.

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* Properly a Pinot, Burgundy type, but much used in blending.

Jura Type.

Characteristics.—Full alcohol, tannin, and body; deep color; very solid wines, with less natural aroma than those of the Medoc.

Principal Varieties.—Sirah, Mondeuse, César, Etraire de l'Adhui, Tinta Valdepeñas, and Persan.

Composition. (According to California analyses.)

	Alcohol by Volume.	Acid as Tartaric.	Tannin.	Body.
Maximum	13.0%	.70%	.350%	4.0%
Minimum	10.0	.45	.200	2.5
Average	12.0	.55	.250	3.0

These show a close approximation to the composition of the Bordeaux varieties as grown in California.

The table of the chemical composition of this type as given above is calculated on analyses of California wines made from Sirah and Mondeuse. The other varieties are included in the type, because they usually make wines similar in character to the above. The Tannat in some localities should be classed with this type.

Southern French Type.

Characteristics.—Alcohol, acid, tannin, and body below medium; color generally tending to orange-red; mostly thin, neutral blending wines.

Principal Varieties.—(*a*) Color light: Aramon, Cinsaut, Grenache, Ploussard, Trousseau, Bastardo, Dolcetto; (*b*) Color light or dark, according to locality: *Carignane*, *Mataro*, Piquepoul, Mourastel; (*c*) Color dark: *Beclan*, *Petit Bouschet*, *Alicante Bouschet.*

Composition. (According to European analyses.)

	Alcohol by Volume.	Acid as Tartaric.	Tannin.	Body.
Maximum	12.0%	.75%	.200%	2.5%
Minimum	8.0	.40	.100	1.8
Average	10.5	.53	.150	2.1

The wines which are taken as typical of this region are those of the plains of the Herault. Wines of somewhat higher character are made in favorable localities, especially in hilly districts, from the same varieties. The same is true in California, where the Carignane, Beclan, Mataro, and even the Bouschets will in some locations make excellent wines approaching the Jura type.

North Italian Type.

Characteristics.—Alcohol full to high, acid high, tannin medium, body full; color (except in the case of the Nebbiolo) deep, mostly violet-red; wines very rough at first, and slow to mature.

Principal Varieties.—Nebbiolo, Barbera, Bonarda, Fresa, Croetto, Favorita, Tadone, Refosco, Neiretta, Marzemino, Lagrain, Gros Mansenc.

Composition. (According to Italian analyses.)

	Alcohol by Volume.	Acid as Tartaric.	Tannin.	Body.
Piedmont—				
Maximum	14.5%	1.00%	.270%	3.2%
Minimum	11.0	.60	.150	2.0
Average	12.0	.80	.220	2.7
Venetia—				
Maximum	11.5	1.20	----	3.0
Minimum	8.5	.80	----	2.3
Average	10.0	1.10	.210	2.7

This type is divided into two groups: that of the wines of the northwest, typified by those of Asti, and that of the country of the lower Po. The latter, being to a large extent grown in plains and made from the acid Refosco, are lower in alcohol and generally thinner and even more acid than the wines of Asti.

There is another type of wine made on the plains of the Po from such grapes as the Dolcetto. They are smooth wines, of little character, used for blending or for early consumption, and resemble the wine of the southern French plains.

The Piedmontese grapes have maintained their characteristics remarkably in California, showing their special adaptation to our conditions. The grapes of the eastern part of northern Italy, the Refosco, Neiretta, Marzemino, though maintaining their high acidity here, have produced more alcoholic wines than they are generally credited with in Venetia. Of the commoner, heavy-bearing varieties of this type, only the Fresa has been tested to any extent. It maintains the characteristic (strawberry) flavor which has suggested its name.

It would thus seem that the grapes of this very pronounced type, which combines in a remarkable degree the properties of high acidity and high saccharine strength, are likely to render important services to the wine industry in this State, especially in its southern portion, where the diminution of acid jeopardizes, or renders impossible, the production of sound and high-flavored wines with the varieties now in general culture.

Austrian and Hungarian Type—Red.

Characteristics.—Alcohol and body medium, acid full, tannin below medium; mostly deep colored, light, quickly maturing wines.

Principal Varieties.—Kadarkas, Grossblaue, Blue Portuguese, Zinfandel.

Composition. (According to European analyses.)

	Alcohol by Volume.	Acid as Tartaric.	Tannin.	Body.
Maximum	13.5%	1.00%	.280%	3.4%
Minimum	8.0	.50	.060	1.4
Average	11.3	.67	.150	2.5

The marked special flavor of the Zinfandel distinguishes it from the other members of this group, but on the whole it is best classed with this somewhat miscellaneous group. Some of the most valuable of the red-wine varieties of southern Austria are placed in the North Italian group, on account of their close resemblance to the grapes of the valley of the Po.

WHITE-WINE TYPES.

Rhenish Type—White.

Characteristics.—(*a*) Common wines: Alcohol low, acid high, body medium to low; clean, fresh-tasting, but neutral wines; (*b*) High-class wines: Alcohol, acid, and body medium, sometimes low; extremely fresh-tasting and aromatic.

Principal Varieties.—White ("Johannisberg") Riesling, Franken Riesling, Traminer, Ruländer, Orleans (Orleans Riesling of California), Kleinberger, Elbling, white and blue.

Composition. (According to König.)

	Alcohol by Volume.	Acid as Tartaric.	Body.
Common and Moselle wines—			
Maximum	8.50%	1.30%	3.00%
Minimum	6.00	.70	1.80
Average	7.30	1.00	2.30
High-class Rhine wines—			
Maximum	12.00	1.00	3.00
Minimum	10.00	.40	1.80
Average	11.50	.50	2.50

The finest and most renowned of these wines are mostly made of the White (Johannisberg) Riesling and Traminer. The Zierfahndler and Ruländer make less aromatic wines, while the neutral blending wines of Franconia are made principally from Franken Riesling and Gutedel (Chasselas). None of the Rhenish grapes make, in California, wines at all approaching in character the common wines of the banks of the Rhine and its tributaries. The Rieslings in some localities make wines of similar composition to that of the finer Rhine wines, but these usually lack freshness and attain too large an amount of alcohol. The Traminer, Ruländer, and Zierfahndler almost always contain too much sugar for complete fermentation. The Gutedel (Chasselas) in some places makes a smooth, neutral wine of moderate alcoholic strength, but it is generally lower in acid here than in Germany, and for that reason this variety has been grouped with the Southern French type, it being derived from that region.

The wines of the Moselle, peculiar for their high aroma, associated with high acid and extremely low alcohol (6% to 8%), are mostly made from the Rieslings.

Burgundy Type—White.

Characteristics.—The white wines of the Burgundy district are of similar character to the red, but are in general more alcoholic. The white wines of the red and white Pinots range in alcoholic contents from 11% to 14%, and even as high as 15%. The white wines of the Gamais vary from 9% to 10% of alcohol, and are used principally for blending. They serve for cutting with the more alcoholic Pinot wines to make a standard blend of 11% to 12% of alcohol for the manufacture of champagnes.

Principal Varieties.—Pinot Chardonay, Pinot blanc, *Franc Pinot*, Gamai blanc, and *Gamai noir.*

Sauterne Type.

Characteristics.—(*a*) Hauts Sauternes: Alcohol and body high; smooth, aromatic, liquorous wines, slightly sweet; (*b*) Graves: Lighter and drier wines, with less aroma.

Principal Varieties.—Semillon, Sauvignon blanc, Muscadelle de Bordelais, Sauvignon vert, Folle blanche.

Composition. (According to European analyses.)

	Alcohol by Volume.	Acid as Tartaric.	Body.
Hauts Sauternes—			
Maximum	15.50%	.75%	3.6%
Minimum	12.00	.65	3.2
Average	13.50	.70	3.4
Graves—			
Maximum	12.30	.71	----
Minimum	11.20	.54	----
Average	11.50	.63	2.0

The analyses of our California Sauternes show lower acidity than is indicated by available analyses for French Sauternes. The composition of the naturally fermented wines in general show a closer resemblance to the white wines of the Graves than to the Hauts Sauternes. The above figures for body show that the profuse amount of sugar allowed in some California Sauternes is not at all in accordance with the composition of the French prototype, which cannot much exceed 1% of unfermented sugar.

Southern French Type—White.

Characteristics.—(*a*) Wines of the plains: Alcohol and body low, acid medium; thin, neutral wines; (*b*) Wines of the hills: Alcohol and body higher; smoother, and more solid wines, but with little character.

Principal Varieties.—Clairette blanche, Marsanne, Roussanne, Verdal (Aspiran blanc and rouge), Chauché gris, Ugni blanc, Chasselas, Listan, *Aramon.*

There is really no distinctive type of white wine peculiar to southern France, though there are certain varieties of grapes characteristic of the region. The white wines of the south of France may be divided into three classes: (*a*) The common wines of the plains, having from 9.5%

to 12% of alcohol by volume, and made principally from Terret, Piquepoul, and Aramon; (*b*) The finer dry white wines, such as Picardans, grown on higher ground, having from 11.0% to 16.0% (average 13.5%) of alcohol by volume, and produced principally by the Clairette blanche; (*c*) The sweet Picardans, Muscats, Roussillon, and other "vins de liqueur." The last class is the most renowned, but the varieties which produce it are not included here, as they have been placed in the liqueur wine group.

For the purpose of the present arrangement the first two classes are considered as forming the white Southern French type. The high alcoholic strength found in some wines of this class is due to a light fortification which is given to some, even of the dry wines.

Austrian and Hungarian Group—White.

Characteristics.—The dry white wines of Austro-Hungary are so diverse that it is difficult to include them in one type. They should more properly be divided into four sub-groups:

1. Fine wines made from the best Rhenish grapes; somewhat heavier and less aromatic than the Rheingau wines.
2. Good table wines, alcohol and acid full, body light. Principal varieties: Wälschriesling, White Velteliner, Rothgipfler, Zierfahndler, Peverella, Furmint, Vernaccia.
3. Lighter table and blending wines, low in alcohol, smooth and clean-tasting. Principal varieties: Rother Steinschiller, Slancamenka, Bakator.
4. Thin, poor wines, low in alcohol and very high in acid, made from heavy-bearing varieties, the principal of which is the Heunisch.

Composition. (According to Austrian analyses.)

	Alcohol by Volume.	Acid as Tartaric.	Body.
1. Average	12.00%	.60%	2.3%
2. Maximum	13.00	.80	----
2. Minimum	11.00	.50	----
2. Average	12.00	.65	2.0
3. Average	10.00	.55	----
4. Average	9.00	.85	----

The grapes of the second and third classes are included in this group. Those of the first class have been discussed with the Rhenish type. Those of the fourth class are undesirable, and have never been tried in California.

A comparison of the above data with the detailed data regarding the composition of the wines of the various grapes in the different localities of this State, will render the intelligent grape-grower and wine-maker an important service in making up proper selections of grapes for his particular locality, or purpose, as the case may be. If more European analyses of wines made from a *single* grape-variety were available, it would doubtless be found that their composition of musts and wines agrees much more closely between Europe and California than now appears from the comparison of the commercial types with our analyses. But, with the single exception of the high-class Riesling wine, all European wines are blends of several varieties, adapted to the taste of the consumers for whom they are destined. Moreover, but very few of the named wines usually sold in California approach with any degree of closeness to their European prototype; for these are, almost throughout, the product of a judicious blending process, which as yet has been very imperfectly developed in California. For, with us, wines have mostly been named more according to the grape of which they are produced; or, if blended, the blend has been guided merely by taste, and that frequently by one not of the most practiced kind. High alcohol, high body, high tannin, have in the past been chiefly spoken of as the desiderata in this State; so that, in fact, until within the last few years the valuation has actually been based largely on the alcohol percentage alone. With such methods of procedure, both in vinification and in blending, it is no wonder that, even where the quality of wine has been good or excellent, constancy of character has been almost unattainable.

I am convinced that, with the proper understanding and utilization of the data given in this report, much of the uncertainty and haphazard heretofore prevailing will disappear, and that both in the selection of the grape-varieties to be planted, and of the proper blends to be made for particular purposes and types, the data imparted by analyses and the records of vinification will be found of the greatest practical use.

PART I.

Investigations of Various Types of Grapes, their Adaptability to Different Localities, and their Value for Wine-Making and Other Purposes; Made During the Seasons of 1887–1894.

By F. T. Bioletti.

Analyses of Musts and Wines.

Made by George E. Colby.

SPECIAL VITICULTURAL STATIONS (under private auspices) that have supplied material for the work here reported:

***West Side Santa Clara Valley Station**; Cupertino, Santa Clara County. John T. Doyle, Patron; Menlo Park.

East Side Santa Clara Valley Station; Mission San José, Alameda County. John Gallegos, Patron; Mission San José.

***Fresno Station**; Fresno City, Fresno County. E. B. Rogers, Patron; Fresno.

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* Discontinued.

DESCRIPTION OF GRAPES RECEIVED AND WINES MADE, WITH ANALYSES OF MUSTS AND WINES.

NOTE.—The classification of grapes and wines here given is made for convenience of reference, in accordance with the most usual or most prominent characters; but of course is not absolute, since one and the same grape may, according to climate, location, and treatment, be made to yield a great variety of wines.

The descriptions of a number of the grape types and varieties originally prepared by Prof. Hilgard for former reports, have, for the most part, been materially increased and rewritten by Mr. Bioletti.

[It will be noticed that in many cases the sugar in the must is higher than the "solid contents by spindle." The error is in the latter determination for the condition, of the must has much to do with the accuracy of the spindle. If in a "mushy" state, the instrument fails to reach its proper level, even on repeated trials, and even when the must has been strained. Filtering is too slow a process and is not practiced in the wineries. In the tables of analyses given in this report, when such discrepancies appear, the sugar test must be regarded as the more reliable.

When grapes are received for examination, it sometimes happens that they are in a partially dried condition, with some of the sugar in a crystallized form. This sugar would, of course, pass into solution in the fermenting-tank; but in the sample taken for the must analysis, some of it would remain undissolved and be lost from the determination of "sugar by copper." The wine would, in such cases, show a greater amount of alcohol than apparently called for by the sugar in the must. Such discrepancies also appear in the tables of analyses, and are to be thus accounted for. (Geo. E. Colby.)]

A. RED-WINE GRAPES.

(Continued from the Report of 1892.)

BORDEAUX, OR CLARET, TYPE.

(For other matters regarding these wines, refer to Vit. Rept. 1887–89, pp. 31–38.)

The production of good, light, clean-tasting table wines has made great progress in California in late years, and among our finer wines of this type it is not hard to find many which have a close and creditable resemblance to the better Medocs. Unfortunately, however, there is still too much wine which aims at the reproduction of this type, but which fails by reason of its harshness, its headiness, its lack of freshness, or its green and undeveloped taste. Wines made from Medoc varieties grown in the most favorable localities are apt to be too rich in the ingredients of good Clarets; they have too much color, too much tannin, too much alcohol, and occasionally too much acid. In fact, they contain all the essentials of good wine, but in too concentrated a form.

It is certainly an improvement to dilute these wines in the making, with a judicious amount of pure water, but this diminishes the body, flavor, and vinosity, and is incompatible with the best results. For commoner wines, the practice of picking the grapes when they show a certain percentage of sugar, say 22%, is occasionally found useful, but if this rule is followed the grapes will often be gathered before maturity, and the resulting wine will be thin, harsh, and green, and lack the fullness and aroma of a fine wine. The best method is to gather the grapes at perfect maturity and blend them in the fermenting-vat, or as soon as possible, with the product of some sound, neutral grape, such as the Aramon, which will dilute their sugar, color, and astringency without injuring their flavor and vinosity. To avoid the extraction of too much color or tannin, an obvious and rational way is to draw the wine off the pomace at the right time—that is, when the desired amount of color and astringency has been extracted. This, with the rich Medoc varieties, will be before the sugar has disappeared, and if care be taken to maintain the proper temperature, there need be no dangerous check of fermentation. It is the practice with some of the best wine-makers to press wines of this type when they show as high as from 8% to 10% of solid contents by the saccharometer. This insures a smooth wine, not too rich in color or tannin, the effect being especially noticeable in the latter ingredient. Drawing off too early must, however, be avoided, or the wine will be flat and lacking in astringency. The pomace, when this early pressing is adopted, contains a large amount of color, tannin, and aromatic principles, which make it very valuable for use in the manufacture of good piquettes or even blending wines.

A slow, cool fermentation is also of great effect in avoiding the harshness which these wines are apt to develop. This is well illustrated by the experience of the Algerian wine-makers, who, since the use of refrigerators has become general, are enabled to produce wines which, after some slight blending and manipulation in Bordeaux, are given to the consumer as genuine Medocs. If this be possible in the dry and heated climate of Algeria, there can be little doubt of the efficacy of the same treatment under the more favorable conditions which obtain in California.

CABERNET SAUVIGNON.

(See Vit. Rept. 1883–85, p. 86; 1886, p. 70; 1887–89, p. 43.)

This variety, the most famed of all red-wine grapes, has now been extensively tried in California, successfully in some places, with poor results in others. In cool localities, where the soil is fairly rich, it is a vigorous grower, shades its grapes well, and bears fair crops. In warmer localities, and on light or dry soil, it is apt to lack enough foliage to properly shade the grapes. This can generally be remedied by close planting and judicious summer pruning. It is a good variety for localities subject to early spring frosts, on account of the late starting of the buds. The berries are solid, well attached to the stalk, and resist rain very well.

The must reaches a good percentage of sugar with sufficient acid.

The average for the coast counties is about 23% to 25% of sugar, with 0.60% to 0.40% of acid. It ferments well, and the wine is one of the best keepers tested. One of the most invaluable qualities of this grape is the exceptional cleanness of the bunches; that is, the absence of rotten, moldy, or broken grapes. This quality has led to its successful use in the making of "levains" or yeasts with which to start other grapes and insure a prompt and pure fermentation.

The greatest faults of the wine of the Cabernet Sauvignon are its excessive astringency and sometimes excessive color. These may be called good faults, for they are easily remedied by blending, and are among the principal causes which make this wine such an excellent keeper. Wines made from this grape in the localities where it attains its highest qualities are so rough, even at the end of three or four years, that they are not agreeable to use alone. One of the best blends for California seems to be one half Cabernet Sauvignon and one half Beclan. The addition of Beclan moderates the tannin, acid, and color of the Cabernet without destroying or disguising its individuality. The usual French blends with Verdot, Merlot, or Malbeck are not suitable for our conditions, as these varieties all possess in a greater or less degree the faults of the Cabernets. At Tulare, the behavior of the Cabernet Sauvignon has been somewhat of a surprise; where the alkali is not too strong, it grows thriftily, makes plenty of foliage, and bears about two to three tons per acre. In strong alkali it is subject to coulure and sunburn. The berries are small, and with little or none of the Cabernet flavor; they are, however, juicy, with fair acid, and make a wine of good color and fair quality, inferior, however, to that of Mondeuse from the same vineyard.

Analyses of Musts and Wines.

CABERNET SAUVIGNON.		Date of Picking	MUST.				WINE.						
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body	Ash
1890—No. 1248.	Margherita Vineyard, Fresno	Aug. 25	22.40	21.80	.65	.32	------	------	------	------	------	------	------
No. 1342.	Mission San José	Oct. 11	22.90	------	.62	.26	9.12	11.36	.252	------	.40	2.78	------
No. 1347.	Cupertino	Oct. 12	24.80	------	.40	------	------	------	------	------	------	------	------
1891—No. 1554.	Paso Robles	Oct. 6	25.65	------	.41	------	------	------	------	------	------	------	------
No. 1591.	Mission San José	Oct. 14	25.40	24.11	.44	------	------	------	------	------	------	------	------
1892—No. 1662.	Amador station	Sept. 16	22.95	------	.57	------	------	------	------	------	------	------	------
No. 1750.	Paso Robles	Oct. 11	24.80	------	.31	------	------	------	------	------	------	------	------
No. 1765.	Mission San José	Oct. 12	21.95	21.22	.77	------	8.70	10.83	.199	.69	.63	2.85	------
1893—No. 1820.	Amador station	Sept. 6	22.70	------	.80	.21	------	------	------	------	------	------	------
No. 1892.	Tulare	Sept. 21	23.70	20.99	.37	------	------	------	------	------	------	------	------
No. 1914.	Paso Robles	Oct. 6	24.80	25.19	.53	.23	9.34	11.64	------	------	.46	3.10	.23
No. 1950.	Mission San José	Oct. 14	22.10	------	.58	------	------	------	------	------	------	------	------
1894—No. 2207.	Tulare	Sept. 25	25.50	24.12	.39	------	------	------	------	------	------	------	------
No. 2282.	Amador station	Oct. 4	25.45	23.61	.53	------	------	------	------	------	------	------	------
No. 2303.	Mission San José	Oct. 11	29.00	------	.47	------	------	------	------	------	------	------	------

Color Readings.

CABERNET SAUVIGNON.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1892—No. 1765.	Mission San José	125.0	1VR	74.2	1VR	72.8	1VR	72.8	1VR	56.3	1VR	43.0	2VR
1893—No. 1914.	Paso Robles	55.5	1VR	27.0	3VR	23.5	3VR	25.0	5VR	11.1	1R	9.3	2R

RECORD OF TREATMENT.

No. 1248. *Cabernet Sauvignon*, from Margherita Vineyard, Fresno. A small sample arrived August 26, 1890, in good condition, well ripened, but both bunches and berries very small. The must showed 22.4% of solid contents. This sample was fermented with No. 1250, Merlot.

No. 1342. *Cabernet Sauvignon*, from Mission San José. Received October 14, 1890, in good condition, and mature. The must showed 22.9% of solid contents by spindle. The temperature of the must at crushing was 68°, and on the fourth day the cap had risen to 86°, and the violent fermentation was over; the next day the wine was dry.

In three weeks from crushing the wine was clear. At four months the wine was racked for the second time, and was bright, much improved, with good flavor, tannin, and acid, but a slightly suspicious taste. A month later the lees showed a few lactic ferments, and the wine was pasteurized. At seven months it was bright and generally good but for its odor. At fourteen months the wine had been racked four times, and was bright, possessed of a full and characteristic flavor, but was somewhat thin and exhausted and had a slight butyric odor. Two months later it was bottled. At two years the bottled wine showed high qualities of flavor, tannin, and acid, but was spoiled by butyric odor.

No. 1347. *Cabernet Sauvignon*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 13, 1890, in fair condition, a few of the grapes moldy and some dried up. The must showed 24.8% of solid contents by spindle.

No. 1554. *Cabernet Sauvignon*, from Paso Robles. A sample for must analysis arrived October 8, 1891, in good condition. The bunches and berries were of medium size for the variety, and the grapes mature. The must showed 25.65% of solid contents by spindle.

No. 1591. *Cabernet Sauvignon*, from Mission San José. A sample for must analysis arrived October 16, 1891, in fair condition. The must showed 25.4% of solid contents by spindle.

No. 1662. *Cabernet Sauvignon*, from Amador station. A sample for must analysis arrived September 19, 1892, in good condition. The must showed 22.95% of solid contents by spindle.

No. 1750. *Cabernet Sauvignon*, from Paso Robles station. A sample for must analysis arrived in good condition. The must showed 24.8% of solid contents by spindle.

No. 1765. *Cabernet Sauvignon*, from Mission San José. Received October 15, 1892, in good condition. The must showed 21.95% of solid contents by spindle. The temperature of the must at crushing was 58°, and the maximum temperature reached was 84°, on the fourth day. On the fifth day the wine was nearly dry, and was pressed.

The wine was somewhat slow in clearing, but at three months was bright and showed rich aroma and flavor, with medium acid and astringency. It improved gradually, preserving its pronounced flavor, and finally losing the slight moldy smell which it had at first. At fourteen months it was very good, but not mature. At twenty-one months it was bottled.

No. 1820. *Cabernet Sauvignon*, from Amador station. A sample for must analysis arrived September 8, 1893, in good condition. The bunches were loosely but fairly well filled with small berries. The grapes had some of the Cabernet flavor. The must showed 22.7% of solid contents by spindle.

No. 1892. *Cabernet Sauvignon*, from Tulare station. A sample for must analysis arrived September 23, 1893, in good condition. The bunches were small and coulured; the berries small, sunburned, and flavorless, but very sweet. The must showed 23.7% of solid contents by spindle.

No. 1914. *Cabernet Sauvignon*, from Paso Robles station. Received October 6, 1893, in fair condition. The bunches and berries were both of good size, the former somewhat affected by coulure. The grapes were well flavored. The must showed 24.8% of solid contents by spindle. The temperature at crushing was 63°, and the maximum reached was 83°, on the fourth day. The fermentation was a little slow toward the end, and the murk was pressed out while still a little sweet. It was left in the fermenting-room for two days after pressing, and at the end of that time was dry.

The wine was nearly clear at the end of six weeks, but was extremely rough. At three months it was bright, possessed of high flavor and aroma, full but agreeable astringency, medium acid, and high body. At seven months it was in excellent condition, and generally a fine wine, but the Cabernet character was not very pronounced.

No. 1950. *Cabernet Sauvignon*, from Mission San José. A sample for must analysis was received October 14, 1893, in bad condition. The bunches were small, well filled with berries of good size. The grapes were highly flavored and mature, but had become moldy by being too long on the road, so were not made into wine. The must showed 22.1% of solid contents by spindle.

CABERNET FRANC.

(See Vit. Rept. 1883-85, p. 84; 1886, p. 68; 1887-89, p. 38.)

The success of this variety has been much more limited than that of its congener, Cabernet Sauvignon. This is partly owing to the fact that unless the cuttings used in planting are carefully selected from well-bearing vines, they are apt to give unproductive or absolutely sterile vines. It is also more deficient in foliage than Cabernet Sauvignon, and in dry soils is liable to be badly sunburned. Close training on wires, and careful summer pruning, may be relied on to counteract this tendency.

Further analyses of this variety show that it maintains its character of full sugar contents, with medium to low acid. A sample of wine made from grapes grown at the Paso Robles station shows the usual high body and medium astringency of this variety; its color was at first good, but lacked stability.

ANALYSES OF MUSTS AND WINES.

CABERNET FRANC.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
						By Weight	By Volume		At Pressing	At Six Months	
1891—No. 1522. Mission San José	Sept. 29	26.95	26.31	.44	-----	-----	-----	-----	-----	-----	-----
No. 1559. Paso Robles	Oct. 6	23.50	-----	.58	-----	-----	-----	-----	-----	-----	-----
1892—No. 1762. Paso Robles	Oct. 11	22.85	-----	.50	-----	-----	-----	-----	-----	-----	-----
1893—No. 2070. Paso Robles	Nov. 3	26.70	25.76	.43	.30	9.92	12.36	.262	.49	.36	3.15
1894—No. 2294. Mission San José	Oct. 10	23.20	-----	.36	-----	-----	-----	-----	-----	-----	-----

COLOR READINGS.

CABERNET FRANC.	At Pressing.		One Month.		Two Months.		Three Months.		Four Months.	
1893—No. 2070. Paso Robles	59.7	VR	38.4	2VR	33.6	5VR	32.8	4VR	8.3	(Y)

Record of Treatment.

No. 1522. *Cabernet Franc*, from Mission San José. A sample for must analysis arrived October 1, 1891. The must showed 26.95% of solid contents by spindle.

No. 1559. *Cabernet Franc*, from Paso Robles. A sample for must analysis arrived October 8, 1891, in good condition. The grapes were large for the variety, and mature. The must showed 23.5% of solid contents by spindle.

No. 1762. *Cabernet Franc*, from Paso Robles. Received October 14, 1892, in good condition. The must showed 22.85% of solid contents by spindle. The grapes were fermented with No. 1761, Tannat, from Paso Robles.

No. 2070. *Cabernet Franc*, from Paso Robles. Received November 3, 1893, in fair condition. The bunches were of medium size, very much branched, irregular, loose, coulured; the berries small, well flavored, but overripe. The must showed 26.7% of solid contents by spindle. The temperature of the must at crushing was 66°, and the maximum of 80° was reached on the third day. The wine was dry on the fifth day, when it was pressed.

The wine was clear at the end of a month, but tasted bitter. At the end of two months it had been racked twice, was clear, very heavy-bodied, with a fairly good flavor, but flat.

MERLOT.

(See Vit. Rept. 1887–89, p. 54.)

This variety has been as distinct a failure in California as the Malbeck, and for the same reason—viz., failure to bear, added to which is its liability to loss of its leaves from sunburn. This is somewhat strange, as in Europe it has the reputation of being a heavy bearer. There, however, it is only planted on cool, northern slopes, for in other positions it ripens too quickly and is easily injured by the sun. The grapes have a very agreeable and distinctive flavor, similar to that of the Cabernet Sauvignon, not, however, perceptible in the wine, which is of a neutral character.

The composition of such grapes as have been analyzed at the station show the effect of growing on too warm an exposure. The sugar contents have been higher on the average, and the acid lower, than in the case of any other of the Bordeaux grapes. The Merlot is particularly unsuited to the Paso Robles district, as, judging from the observations made at that station, and from the analyses of musts received from there, its defects are emphasized and it loses much of its flavor and color.

Analyses of Musts and Wines.

MERLOT.		Date of Picking	MUST.				WINE.	
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Tannin	Total Acid as Tartaric at Pressing
1890—No. 1218.	Fresno	Aug. 22	23.70	------	.28	------	------	--------
No. 1366.	Cupertino	Oct. 14	26.30	------	.38	------	------	--------
No. 1380.	Mission San José	Oct. 19	28.80	------	.40	------	------	--------
1891—No. 1586.	Mission San José	Oct. 14	25.90	24.96	.36	.44	------	--------
1893—No. 1955.	Paso Robles	Oct. 15	28.40	28.33	.29	.33	.326	.41
No. 1993.	Mission San José	Oct. 19	25.90	------	.58	------	.451	.68
No. 2060.	Cupertino	Oct. 31	26.30	------	.51	------	.294	.74
1894—No. 2259.	Mission San José	Oct. 3	23.70	------	.49	------	------	--------

COLOR READINGS.

MERLOT.		At Pressing.	
1893—No. 1955.	Paso Robles	27.4	5VR
No. 1993.	Mission San José	121.0	VR
No. 2060.	Cupertino	48.2	3VR

RECORD OF TREATMENT.

No. 1218. *Merlot*, from Margherita Vineyard, Fresno. A sample for must analysis arrived August 25, 1890, in good condition, overripe, and some of the grapes dried. The must showed 23.7% of solid contents by spindle.

No. 1366. *Merlot*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 17, 1890, in good condition, a little overripe, the berries a little shriveled, but not dried up. The must showed 26.3% of solid contents by spindle.

No. 1380. *Merlot*, from Mission San José. A sample for must analysis arrived October 20, 1890, in fair condition, mature, and a few of the grapes dried. The must showed 28.8% of solid contents by spindle.

No. 1586. *Merlot*, from Mission San José. A sample for must analysis arrived October 16, 1891, in fair condition. The bunches were loose and straggling, the berries small. The must showed 25.9% of solid contents by spindle.

No. 1955. *Merlot*, from Paso Robles. A sample for must analysis and for color and tannin tests arrived October 15, 1893, in fair condition. The bunches were large, irregular, loose, and winged; the berries small, round, on long, slender pedicels. The grapes were of good flavor, and mature. The must showed 28.4% of solid contents by spindle.

No. 1993. *Merlot*, from Mission San José. A sample for must analysis and for color and tannin tests was received October 19, 1893, in good condition. The bunches were of medium size, irregular, loose, and branching; the berries small; the peduncles and pedicels very slender. The grapes were mature and highly flavored. The must showed 25.9% of solid contents by spindle.

No. 2060. *Merlot*, from J. T. Doyle, Cupertino. A sample for must analysis and for color and tannin tests was received October 31, 1893, in good condition. The bunches were small, spreading, well filled, but not close; the berries small, round, firm, of characteristic flavor, quite mature. The must showed 26.3% of solid contents by spindle.

MALBECK OR CÔT.

(See Vit. Rept. 1883-85, p. 83; 1886, p. 87; 1887-89, p. 32.)

The latest tests of the Malbeck have developed no new points in its favor, but have, on the contrary, proved pretty conclusively its unfitness for Tulare and similar localities. It has not borne well at any of the stations; at Paso Robles, where it has done best, it gave less than two tons to the acre. On the whole, it seems better adapted to the conditions at Paso Robles than at any other locality tried so far; it gives a wine of good body, acid, and astringency. It commenced with an amount of color equal to that attained at Cupertino, but dropped it very badly. It has in this locality shown the excellent quality of retaining a good amount of acid, even when somewhat overripe and very high in sugar. In general, the composition of the must is satisfactory wherever the variety has been grown; but so far no locality has been tested where it overcomes its radical defect of unfruitfulness (in consequence of coulure or failure to set), which at Mission San José has continued to characterize it to such extent as to amount to absolute failure.

Analyses of Musts and Wines.

MALBECK.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
							By Weight	By Volume		At Pressing	At 6 to 8 Months	
1890—No. 1303.	Mission San José	Oct. 5	24.55	------	.56	.38	------	------	------	------	------	------
No. 1321.	Cupertino	Oct. 11	25.20	------	.53	------	------	------	------	------	------	------
1891—No. 1475.	Fresno	Aug. 29	25.00	24.64	.55	.51	------	------	------	------	------	------
No. 1489.	Paso Robles	Sept. 9	28.80	29.07	.54	------	------	------	------	------	------	------
1892—No. 1653.	Paso Robles	Sept. 13	22.15	21.80	.53	.34	------	------	------	------	------	------
No. 1665.	Amador station	Sept. 16	24.25	------	.58	------	------	------	------	------	------	------
No. 1679.	Tulare	Sept. 17	22.80	------	.44	------	------	------	------	------	------	------
1893—No. 1797.	Tulare	Aug. 31	21.10	18.90	.62	.45	7.43	9.27	.298	.51	.67	3.80
No. 1817.	Amador station	Sept. 8	21.50	20.99	.78	.26	------	------	.294	.72	------	------
No. 1917.	Paso Robles	Oct. 7	26.30	24.64	.50	.38	9.85	12.20	.272	.48	.44	3.30
No. 2055.	J. T. Doyle, Cupertino	Oct. 31	25.20	------	.62	------	------	------	.384	.90	------	------
1894—No. 2208.	Tulare	Sept. 20	22.60	------	.53	------	------	------	------	------	------	------
No. 2274.	Mission San José	Oct. 3	22.60	------	.50	------	------	------	------	------	------	------

Color Readings.

MALBECK.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1893—No. 1797.	Tulare	33.3	1VR	32.5	5VR	19.1	R	17.6	2R	17.4	2R	------	------
No. 1817.	Amador station	70.2	1VR	------	------	------	------	------	------	------	------	------	------
No. 1917.	Paso Robles	90.9	VR	35.4	1VR	27.9	1VR	28.8	2VR	9.3	(Y)	8.7	(Y)
No. 2055.	Cupertino	90.9	VR-1VR	------	------	------	------	------	------	------	------	------	------

RECORD OF TREATMENT.

No. 1303. *Malbeck*, from Mission San José. A sample for must analysis arrived October 7, 1890, in bad condition. The must showed 24.55% of solid contents by spindle. The grapes were fermented with No. 1302, Tannat, from Mission San José.

No. 1321. *Malbeck*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 13, 1890, in bad condition. The must showed 25.2% of solid contents by spindle.

No. 1475. *Malbeck*, from Margherita Vineyard, Fresno. A sample for must analysis and color test arrived August 31, 1891, in fair condition. The must showed 25.0% of solid contents by spindle.

No. 1489. *Malbeck*, from Paso Robles station. A sample for must analysis arrived September 11, 1891, in good condition. The must showed 28.8% of solid contents by spindle.

No. 1653. *Malbeck*, from Paso Robles station. A sample for must analysis and color test arrived September 16, 1892, in good condition. The must showed 22.15% of solid contents by spindle.

No. 1665. *Malbeck*, from Amador station. A sample for must analysis arrived September 19, 1892, in poor condition. The must showed 24.25% of solid contents by spindle.

No. 1679. *Malbeck*, from Tulare station. A sample for must analysis arrived September 21, 1892, in good condition. The must showed 22.8% of solid contents by spindle.

No. 1797. *Malbeck*, from Tulare station. Received August 31, 1893, in good condition. The bunches were well filled, the berries of good size and well colored, but tasteless. The must showed 21.1% of solid contents by spindle. The must at crushing had a temperature of 63°, and was very slow in starting. On the fifth day the fermentation was so slow that it was hastened by placing the vat in an outside temperature of 90°. This had the desired effect, and in three days more the wine was dry. The maximum temperature reached was 96°, on the seventh day.

The wine became clear in a month, but soon commenced to deteriorate. At three months it was very flat and inferior, and at seven months quite spoiled.

No. 1817. *Malbeck*, from Amador station. A sample for must analysis and for color and tannin tests was received September 8, 1893, in good condition. The bunches were close, medium sized; the berries of medium size and good flavor. The must showed 21.5% of solid contents by spindle.

No. 1917. *Malbeck*, from Paso Robles station. Received October 7, 1893, in somewhat crushed condition, but not moldy. The bunches were small, but well filled; the berries of medium size, very ripe, and of good flavor. The must showed 26.3% of solid contents by spindle. The initial temperature of the must was 68°, and the maximum temperature reached, on the third day, 84°. The fermentation was finished on the sixth day.

Three weeks from pressing, the wine was nearly clear and was very astringent. At three months it was clear, of good color and flavor, full-bodied, and with plenty of astringency, but not quite clean-tasting. At seven months it had improved and developed some bouquet, but the after-taste was not good and was slightly bitter.

No. 2055. *Malbeck*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 31, 1893, in good condition. The bunches were small and coulured; the berries of medium size, crisp, juicy, well flavored, and quite mature. The must showed 25.2% of solid contents by spindle.

VERDOT.

(See Vit. Rept. 1883-85, p. 88; 1885, p. 71; 1887-88, p. 60.)

The Gros and the Petit Verdot seem to be simply variations of the same variety produced by selection; the former is a better bearer and produces larger berries. But there is little or no difference in the character of the wine. This variety has succeeded much better than either the Malbeck or the Merlot, bearing fair crops and, though possessing a less dense foliage, generally shading its grapes sufficiently. It is vigorous, but requires long-pruning and a fairly rich soil. The young canes are brittle and liable to damage from the wind in the spring. The average crop in suitable soil is about three to four tons per acre, but less when the soil is too light or too dry. The average crop at Cupertino has been about two tons per acre. At Tulare the crop has been about the same, but the vine does not do well in alkali soil.

The Verdot ripens later than the Cabernets, and while attaining an almost equal amount of sugar, retains a much higher acidity. The average composition of the must in ordinary years is—at Cupertino, 24.5% of sugar and 0.86% of acid; at Mission San José, 24.5% of sugar and 0.84% of acid; at Tulare, 24% of sugar and 0.53% of acid; at Paso Robles, 24.2% of sugar and 0.47% of acid. This shows good acidity, even at the southerly stations. The must is thus easily fermented, and produces a wine of excellent keeping qualities. The wine is very astringent, but less rough at first than Cabernet Sauvignon, to which, however, it is much inferior in distinctive flavor. Its most profitable use is as a blend with high-class wines needing an addition of acid and tannin.

Analyses of Musts and Wines.

VERDOT.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
						By Weight	By Volume		At Pressing	At 6 to 8 Months	
1890—No. 1223. Fresno	Aug. 22	23.70	23.62	.57	.33	------	------	------	------	------	------
No. 1250. Fresno	Aug. 25	24.10	23.62	.57	.27	9.70	12.09	.278	.41	.57	3.08
No. 1331. Cupertino	Oct. 1	21.05	------	.92	------	------	------	------	------	------	------
No. 1382. Mission San José	Oct. 18	25.00	------	.99	.23	9.92	12.36	.320	------	.39	3.32
1891—No. 1551. Paso Robles	Oct. 6	23.40	------	.39	------	------	------	------	------	------	------
No. 1592. Mission San José	Oct. 13	24.00	24.11	.82	.40	10.44	11.91	.291	.67	.49	3.20
1892—No. 1681. Tulare	Sept. 19	23.70	------	.39	------	------	------	------	------	------	------
No. 1726. Paso Robles	Oct. 10	25.90	------	.48	------	------	------	------	------	------	------
No. 1736. Paso Robles	Oct. 10	20.60	------	.53	------	------	------	------	------	------	------
1893—No. 1828. Amador station	Sept. 8	21.50	------	1.23	------	------	------	.386	1.13	------	------
No. 1935. Paso Robles	Oct. 13	26.95	26.24	.49	.31	------	------	.534	.41	------	------
No. 1942. Tulare	Oct. 13	22.35	21.38	.63	.23	------	------	.438	.56	------	------
No 1991. Mission San José	Oct. 19	24.10	------	.92	------	------	------	.425	.85	------	------
No. 2043. Cupertino	Oct. 31	25.70	------	1.10	------	------	------	.355	.94	------	------
No. 2115. Cupertino	Nov. 6	26.30	------	1.15	------	------	------	.400	.79	------	------
No. 2124. Cupertino	Nov. 6	25.70	------	1.01	------	------	------	------	------	------	------
1894—No. 2306. Mission San José	Oct. 10	25.00	------	.64	------	------	------	------	------	------	------
No. 2317. Tulare	Oct. 13	26.00	------	.47	------	------	------	------	------	------	------

COLOR READINGS.

VERDOT.		At Pressing.	One Month.	Two Months.	Three Months.	Four Months.
1891—No. 1592.	Mission San José	120 VR	88.8 2VR	58.0 2VR	58.0 2VR	41.2 2VR
1893—No. 1828.	Amador	174 VR	111.0 1VR	....	....	....
No. 1935.	Paso Robles	100 VR	....	....	....	....
No. 1942.	Tulare	69 VR	....	....	....	....
No. 1991.	Mission San José	133 VR	....	....	....	....
No. 2043.	Cupertino	114 1VR	....	....	....	....
No. 2115.	Cupertino	87 1VR	....	....	....	....

RECORD OF TREATMENT.

No. 1223. *Petit Verdot*, from Margherita Vineyard, Fresno. A sample for must analysis was received August 25, 1890, in good condition, but a little overripe. The must showed 23.7% of solid contents by spindle.

No. 1250. *Petit Verdot*, from Margherita Vineyard, Fresno. Received August 27, 1890, in good condition. The bunches were small; the berries small, thin-skinned, and juicy. The must showed 24.1% of solid contents by spindle. The temperature of the must at crushing was 69°, and the highest temperature reached during fermentation was 92°, on the fourth day. The murk was drawn off and the pomace pressed on the sixth day, though a little sugar still remained. This sample was fermented with No. 1248, Cabernet Sauvignon, from the same vineyard. The proportion of each variety was Verdot 78%, Cabernet 22%.

Blend of Verdot and Cabernet Sauvignon. The wine fermented slowly for some time, but was quite dry at the end of a month. At two months it was clear, of fair color, medium astringency and acid, but flat and of suspicious taste. At three months the lees showed lactic filaments and the taste was affected; aside from this the wine was of rather good quality. A few days after this it was pasteurized. After pasteurizing, the wine was racked twice, and gradually improved, losing its lactic taste and becoming bright. The wine was bottled, part at eighteen months and part at twenty-four months. At twenty-eight months both wines were tasted and found bright and with fairly good color. That first bottled had the most flavor, but the other was the cleaner-tasting, though neither wine was quite fresh or clean-tasting.

No. 1331. *Gros Verdot*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 3, 1890, in good condition, and mature. The must showed 21.05% of solid contents by spindle.

No. 1382. *Petit Verdot*, from Mission San José. Received October 20, 1890, in very good condition; the bunches and berries were extremely small. The must showed 25.0% of solid contents by spindle. The temperature of the must at starting was 68°, and the maximum, reached on the third day, was 93°. The murk was dry on the fourth day, and was drawn off.

At one month the wine was clear, of good flavor, high astringency, medium acid, and full body. At three months the wine was racked for the second time and, the lees showing some lactic filaments, it was pasteurized. It was bright, of good bouquet and flavor, and the lactic tint was not perceptible to taste. At seven months it had improved, and was full flavored and very good, but still very rough. At fourteen months it had improved, and kept well in spite of the small size of the sample (three gallons), and was quite mature. At sixteen months it was bottled. At one year after bottling the wine was bright and of high quality and remarkably clean-tasting, considering the small size of the sample made.

No. 1551. *Gros Verdot*, from Paso Robles station. A sample for must analysis arrived October 8, 1891, in good condition. The bunches were small; the berries of medium size and mature. The must showed 23.4% of solid contents by spindle.

No. 1592. *Petit Verdot*, from Mission San José. Received October 16, 1891, in fair condition. The must showed 24.0% of solid contents by spindle. The temperature of the grapes at crushing was 69°, and the highest reached was 80°, on the third day. The murk was dry on the fourth day, and was drawn off.

But two gallons of wine were made, and consequently it soon became flat. It showed, however, remarkable keeping qualities, and successive tastings at one, two, four, seven, and nine months show a gradual improvement of flavor. It was put in glass at nine months.

No. 1681. *Gros Verdot*, from Tulare station. A sample for must analysis was received September 21, 1892, in good condition. The must showed 23.7% of solid contents by spindle.

No. 1726. *Petit Verdot*, from Paso Robles station. A sample for must analysis arrived October 13, 1892, in good condition. The grapes were very small. The must showed 25.9% of solid contents by spindle.

No. 1736. *Gros Verdot*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 20.6% of solid contents by spindle.

No. 1828. *Gros Verdot*, from Amador station. See No. 1828, Petit Verdot.

No. 1828. *Petit Verdot and Gros Verdot*, from Amador station. A sample for must analysis and for tannin and color tests was received September 8, 1893, in good condition. The Petit Verdot was very small and coulured, the Gros Verdot had small bunches well filled with larger berries; the grapes were well colored. The must showed 21.5% of solid contents by spindle.

No. 1935. *Petit Verdot*, from Paso Robles station. A sample for must analysis and for color and tannin tests was received October 13, 1893, in good condition. The bunches were small and loose; the berries very small, mature, and well flavored. The must showed 26.95% of solid contents by spindle.

No. 1942. *Petit Verdot*, from Tulare station. A sample for must analysis and for color and tannin tests was received October 13, 1893, in good condition. The bunches were small, close, regularly short cylindrical; the berries of medium size, fresh-tasting, mature, with good acid. The must showed 22.35% of solid contents by spindle.

No. 1991. *Petit Verdot*, from Mission San José. A sample for must analysis and for color and tannin tests was received October 19, 1893, in good condition. The bunches were small to medium, well filled, but not compact; the berries small, equal, quite mature. The must showed 24.1% of solid contents by spindle.

No. 2043. *Gros Verdot*, from J. T. Doyle, Cupertino. A sample for must analysis and for color and tannin tests was received October 31, 1893, in good condition. The bunches were small, cylindrical, often in two branches, loose, coulured; the berries of medium size, commencing to dry up, but still with good acid. The must showed 25.7% of solid contents by spindle.

No. 2115. *Petit Verdot*, from J. T. Doyle, Cupertino. A sample for must analysis and for color and tannin tests was received November 6, 1893, in good condition. The bunches were under medium size, close, conical to cylindrical, with small shoulders; the berries under medium size, firm, juicy, sweet, but with very few dried berries. The must showed 26.3% of solid contents by spindle.

No. 2124. *Gros Verdot*, from J. T. Doyle, Cupertino. A sample for must analysis was received November 6, 1893, in good condition. The bunches were over medium size, much winged, loose, on slender red peduncles; the berries of medium size, round, crisp, commencing to shrivel, but with good acid. The must showed 25.7% of solid contents by spindle.

GAMAI TEINTURIER.

(See Vit. Rept. 1885, p. 86; 1887-89, p. 71.)

This is a grape deserving of more extended attention than it has yet received. It is not a very vigorous grower, but is fairly resistant to coulure, rain, etc., and with long-pruning gives fair crops (two to four tons per acre, at Cupertino). At Tulare station it is planted in alkali too strong for any variety, but the composition of the must is very satisfactory. The grapes are of medium size, not too compact, and ripen about two weeks before the Cabernet Sauvignon. The average composition of the must in ordinary years is: at Cupertino, 23.9% of sugar and 0.82% of acid; at Mission San José, 24.7% of sugar and 0.77% of acid; at Tulare, 26.2% of sugar and 0.64% of acid; at the Amador station, 23.1% of sugar and 0.73% of acid; at Paso Robles, 23.0% of sugar and 0.68% of acid. Thus, at all stations, with a full or somewhat high percentage of sugar, it maintains uniformly a good percentage of acid. The composition of the must insures a quick and thorough fermentation; the wine is without special flavor, but full-bodied, fresh-tasting, and quick to mature.

As a color wine, it is much superior in California to the Teinturiers, in having an almost equal amount of color and superior keeping qualities. The color is particularly stable, both in tint and intensity. Though essentially in character a grape of the Bordeaux type, it would make an excellent blend for correcting the faults of our Pinots in some districts, where they are subject to the mannitic or other injurious after-fermentations. It would give them the color, acid, and keeping qualities they need, without disguising or spoiling their own peculiar flavor and bouquet.

Its tannin content, as a rule, is adequate, but not high, so that the wine is never so intensely rough as the Carbernets often are.

ANALYSES OF MUSTS AND WINES.

GAMAI TEINTURIER.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—No. 1228.	Fresno	Aug. 23	25.40	25.76	.64	.40	------	------	------	------	------	------
No. 1276.	Cupertino	Oct. 1	21.93	------	.80	.23	9.25	11.45	.202	.84	.52	2.58
1891—No. 1580.	Mission San José	Oct. 13	26.80	26.99	.65	------	11.23	13.73	.307	.75	.50	2.70
1892—No. 1684.	Mission San José	Sept. 24	24.10	------	.93	------	9.49	11.82	.232	.84	.86	3.10
No. 1663.	Amador station	Aug. 30	25.86	------	.58	------	------	------	------	------	------	------
1893—No. 1823.	Amador station	Sept. 8	20.20	------	.88	------	------	------	.253	1.00	------	------
No. 1866.	Paso Robles	Sept. 15	23.05	20.99	.68	.24	8.48	10.58	.122	.56	.55	2.95
No. 1893.	Tulare	Sept. 25	26.90	24.12	.64	.40	------	------	.317	.71	------	------
No. 1945.	Mission San José	Oct. 14	23.20	------	.87	------	------	------	.428	.86	------	------
No. 2128.	Cupertino	Nov. 6	26.50	------	.68	------	------	------	.349	.71	------	------
1894—No. 2265.	Mission San José	Oct. 3	25.65	------	.80	------	------	------	------	------	------	------

COLOR READINGS.

GAMAI TEINTURIER.		At Pressing.	One Month.	Two Months.	Three Months.	Four Months.	Five Months.
1891—No. 1580.	Mission San José	149.0 1VR	102.6 2VR	100.0 2VR	46.5 2VR	52.0 4VR	------
1892—No. 1684.	Mission San José	142.0 1VR	118.0 2VR	103.0 2VR	90.9 1-2VR	81.6 2VR	69.0 2VR
1893—No. 1823.	Amador station	64.5 1VR	------	------	------	------	------
No. 1866.	Paso Robles	22.3 R	17.4 4VR	13.4 5VR	10.5 5VR	11.9 5VR	11.1 5VR
No. 1893.	Tulare	22.6 1R	------	------	------	------	------
No. 1945.	Mission San José	154.0 1VR	------	------	------	------	------
No. 2128.	Cupertino	100.0 1VR	------	------	------	------	------

RECORD OF TREATMENT.

No. 1228. *Gamai Teinturier*, from Margherita Vineyard, Fresno. A sample for must analysis was received August 25, 1890, in good condition, but some of the grapes had commenced to dry up. The must showed 25.4% of solid contents by spindle.

No. 1276. *Gamai Teinturier*, from J. T. Doyle, Cupertino. Received October 2, 1890, in fair condition. Grapes small and not quite mature; a few bunches moldy. The must showed 21.93% of solid contents by spindle. The temperature of the grapes at crushing was 66°, and the highest temperature reached was 89°, on the fourth day. The murk was dry on the sixth day, and was drawn off.

The wine fermented slowly for some time and was a little slow in clearing, but in two months it was clear, with good acid and astringency, but with a slight odor of mold. At four months the lees showed a little lactic taint, so the wine was pasteurized. The lactic taint was not perceptible to taste, and the wine was clear. Four months after pasteurizing it was bright, with little bouquet but agreeable flavor, and generally improved. At ten months it was racked for the third time; at fifteen months it was bright, had rich ruby color, little bouquet, full rich flavor, with no trace of moldiness; mature, and of good quality. It was bottled—part at seventeen and part at twenty-three months. At twenty-seven months both samples were tasted. That bottled at seventeen months was flat, cloudy, and of poor quality; that bottled at twenty-three months was in excellent order, very smooth, agreeable, and clean-tasting.

No. 1580. *Gamai Teinturier*, from Mission San José. Received October 16, 1891, in fair condition. The must showed 26.8% of solid contents by spindle. The temperature of the must at starting was 68°, and the maximum temperature arrived at was 86°, on the third day. On the fourth day the murk was drawn off nearly dry.

At one month the wine was clear, smooth, and full-bodied, but a little flat. At two months the lees showed lactic germs, so the wine was pasteurized. A month later the wine was sound, but lacked freshness. At seven months it was much improved, had developed some bouquet, and tasted cleaner and fresher. It continued to improve and develop character till it was fifteen months old, when it was bottled. At three years and a half the wine in bottle was bright, deep-colored, with good flavor and some bouquet; it was a solid wine with good astringency and body, and medium acid.

No. 1684. *Gamai Teinturier*, from Mission San José. Received September 27, 1892, in good condition. The must showed 24.1% of solid contents by spindle. The temperature of the must at starting was 68°, and the highest temperature reached was 94°, on the third day. The murk was dry on the fifth day, and was drawn off.

The wine was clear within a month from crushing. At three months it was bright, the bouquet good, acid very sharp, flavor not marked. It improved with age, and at five months, when it was racked for the second time, it was smoother, but the acid was still harsh. It remained bright and sound, and at eighteen months was put in bottle.

No. 1663. *Gamai Teinturier*, from Amador station. Received September 1, 1892, in poor condition. The must showed 25.86% of solid contents by spindle.

No. 1823. *Gamai Teinturier*, from Amador station. A sample for must analysis and for color and tannin tests was received September 8, 1893, in good condition. The bunches were small and well filled, with good-sized berries, well colored and ripe. The must showed 20.2% of solid contents by spindle.

No. 1866. *Gamai Teinturier*, from Paso Robles station. Received in good condition September 15, 1893. The bunches were well filled and of good size; the berries somewhat shriveled; the juice only slightly pink. The must showed 23.05% of solid contents by spindle. The temperature of the grapes at crushing was 67°, and the highest temperature reached was 89°, on the fourth day. The murk was drawn off dry on the fifth day. In one month the wine was clear, but tasted a little moldy. At four months it was bright, very light in color for the variety, full acid and good flavor. At eight months it had been racked twice, and was much improved, had developed some bouquet, and possessed some flavor; the after-taste was not perfectly clean.

No. 1893. *Gamai Teinturier*, from Tulare station. The grapes arrived on September 25, 1893, in good condition; they were very sweet and past maturity; the bunches and berries were small; the juice slightly pink. The must showed 26.9% of solid contents by spindle. Only a sample for analysis and for color and tannin tests was received.

No. 1945. *Gamai Teinturier*, from Mission San José. A sample for must analysis and for tannin and color tests was received October 14, 1893, in bad condition, having been too long on the road. The grapes were overripe and beginning to dry up. The must showed 23.2% of solid contents by spindle.

No. 2128. *Gamai Teinturier*, from J. T. Doyle, Cupertino. A sample for must analysis and for tannin and color tests was received November 6, 1893, in good condition. The bunches were conical, close, under medium size; the berries of medium size, soft and shriveled, much overripe. The must showed 26.5% of solid contents by spindle.

TEINTURIER.

(See Vit. Rept. 1885, p. 86; 1887, p. 77.)

There are two varieties of the Teinturier, known, according to Mas and Pulliat, as Teinturier mâle (or Dix fois coloré) and Teinturier femelle (or Cinq fois coloré). They deserve mention as having been somewhat widely distributed in California, luckily only in small quantities. The former is also called in California, but erroneously, Pied de Perdrix. It is the more deeply colored, but lacks vigor and bears sparingly. The other, known generally simply as Teinturier, is slightly more productive. Neither variety can be recommended either for quality or quantity, and are both equaled if not surpassed as coloring grapes by the Petit Bouschet, Gamai Teinturier, and even by several grapes with white juice. The two varieties are easily distinguished by the leaves; those of the Teinturier mâle are red from the beginning, while those of the Teinturier femelle only turn red as they commence to mature. Moreover, the canes of the Teinturier mâle show in the cross-section a red center spot which the other does not. It is rare to find either variety with bunches having sound berries throughout.

Analyses of Musts and Wines.

TEINTURIER.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—No. 1205.	Fresno	Aug. 12	24.55	24.43	.48	.54	9.34	11.64	.210	.46	.38	3.20
No. 1235.	Fresno	Aug. 23	22.00	21.80	.71	.43						
No. 1283.	Cupertino	Oct. 1	25.20		.70	.32	9.92	12.36	.359	.54	.32	3.28
No. 1292.	Mission San José	Oct. 1	23.60		.80	.21	9.34	11.64	.310	.71	.37	2.78
1891—No. 1497.	Paso Robles	Sept. 13	21.50	20.99	.57	.33	7.99	10.00	.100	.53	.53	3.05
No. 1521.	Mission San José	Oct. 1	25.90	25.19	.60		10.26	12.13	.311	.74	.59	3.05
No. 1587.	Mission San José	Oct. 14	27.55	26.99	.55							
1892—No. 1666.	Amador station	Sept. 17	26.25		.56							
No. 1710.	Mission San José	Oct. 3	25.00		.70	.32						
1893—No. 1831.	Amador station	Sept. 8	23.70		.60				.361	.75		
No. 1943.	Tulare	Oct. 13	23.45		.74							
No. 1946.	Mission San José	Oct. 14	25.90		.85				.547	.83		
No. 2121.	Cupertino	Nov. 7	26.10		.50				.531			
1894—No. 2151.	Tulare	Sept. 17	24.55		.57							
No. 2196.	Amador station	Sept. 26	28.00		.33							
No. 2271.	Mission San José	Oct. 5	22.70		.53				.305			

Color Readings.

TEINTURIER.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1891—No. 1497.	Paso Robles	15.2	3R+Y	5.5	1VR+Y	6.2	3VR+Y	6.1	3VR+Y	6.3	5VR+Y	4.7	1R+Y
No. 1521.	Mission San José	149.0	2VR	83.3	1VR	58.0	1-2VR	62.5	2VR	54.8	3VR	44.4	3VR
1893—No. 1831.	Amador station	78.4	1VR	61.6	1VR								
No. 1946.	Mission San José	182.0	VR										
No. 2121.	Cupertino	111.0	1VR										
1894—No. 2271.	Mission San José	95.2	VR										

RECORD OF TREATMENT.

No. 1205. *Teinturier mâle*, from Margherita Vineyard, Fresno. Received August 15, 1890, in good condition, perfectly ripe, and a few grapes commencing to shrivel; the bunches were of good size. The must showed 24.55% of solid contents by spindle. The temperature of the grapes at crushing was 69°, and the maximum temperature reached was 83°, on the fourth day. The murk was dry on the sixth day, and was drawn off.

The wine was clear in five weeks from pressing. It was at first coarse, but sound and full-bodied, with plenty of tannin and alcohol, and moderate acid. At four months it was bright and generally much improved, agreeably flavored, and with some bouquet. The lees, however, showed a few lactic ferments, so the wine was pasteurized. Successive tastings showed a gradual improvement up to eight months, after which the wine lost in freshness and color. At fifteen months it was bright, very lightly colored for a Teinturier, with good bouquet and flavor, but somewhat exhausted. At seventeen months it was bottled. It was tasted two years after bottling, and found bright, sound, and in good condition, without bad taste, but insipid and neutral.

No. 1235. *Pied de Perdrix*, from Margherita Vineyard, Fresno. A sample for must analysis was received August 25, 1890, in poor condition, and not mature. The must showed 22.0% of solid contents by spindle.

No. 1283. *Teinturier mâle*, from J. T. Doyle, Cupertino. Received October 3, 1890, in fairly good condition. The bunches were often undersized, with many undeveloped berries. The must showed 25.2% of solid contents by spindle. The temperature of the must at crushing was 64°, and the maximum temperature reached was 94°, on the fourth day. The murk was dry on the sixth day, when it was drawn off.

The wine was a little slow in clearing, but at two months it was clear; it was a heavy, very astringent wine of neutral flavor. At three months the lees showed some lactic taint, and the taste had become affected; the wine was pasteurized. After this the wine improved somewhat, became smoother, and retained its high color, but lacked freshness and character. At eighteen months it was bottled, but it did not keep well in glass.

No. 1292. *Teinturier mâle*, from Mission San José. Received October 3, 1890, in good condition. The bunches were well filled and the grapes mature. The must showed 23.6% of solid contents by spindle. The temperature of the grapes at crushing was 63°, and the maximum temperature reached was 87°, on the third day.

The wine was slow in clearing, and commenced to go wrong almost from the beginning; it was heavy-bodied and highly astringent. It was pasteurized at three months, and improved a little after that; it was, however, always a flat and insipid wine, and did not keep well in bottle.

No. 1497. *Teinturier mâle*, from Paso Robles station Received September 16, 1891, in good condition. The must showed 21.5% of solid contents by spindle. The temperature of the grapes at crushing was 68°, and the maximum reached was 83°, on the second day. On the third day the murk was nearly dry, and was drawn off.

Three weeks from pressing, the wine was nearly clear and quite dry. At two months it was bright, with very little color, coarse, and earthy. Successive tastings show no improvement; the wine remained clear, but was thin, flat, and without character.

No. 1521. *Teinturier mâle*, from Mission San José. Received October 2, 1891, in good condition. The must showed 25.9% of solid contents by spindle. The temperature of the grapes at crushing was 69°, and the highest temperature reached was 84°, on the fourth day. The murk was dry on the fifth day, when it was drawn off.

The wine was a little slow in clearing, and tasted flat. Within a month from pressing the lees showed lactic ferments. The wine was pasteurized at two months. After this the wine became bright and improved somewhat. It soon, however, became decrepit, owing principally, perhaps, to the smallness of the sample.

No. 1587. *Pied de Perdrix*, from Mission San José. A sample for must analysis was received October 16, 1891, in poor condition. The must showed 27.55% of solid contents by spindle.

No. 1666. *Teinturier mâle*, from Amador station. A sample for must analysis arrived September 19, 1892, in poor condition. The must showed 26.25% of solid contents by spindle.

No. 1710. *Teinturier mâle*, from Mission San José. Received October 5, 1892, in fair condition. The must showed 25.0% of solid contents by spindle. This sample was fermented with No. 1709, Bastardo, from Mission San José.

No. 1831. *Teinturier mâle*, from Amador station. A sample for must analysis and for color and tannin tests was received September 8, 1893, in good condition. The bunches were small, but the berries of good size. The must showed 23.7% of solid contents by spindle.

No. 1943. *Teinturier mâle*, from Tulare station. A sample for must analysis was received October 13, 1893, in good condition. The bunches were very small, loose, much coulured; the berries small and overripe, mixed with second crop, to which is doubtless due the somewhat high acid of the must. The must showed 23.45% of solid contents by spindle.

No. 1946. *Teinturier mâle*, from Mission San José. A sample for must analysis and for color and tannin tests was received October 14, 1893, in poor condition. The juice was very deeply colored. The grapes were not as much shriveled as the Gamai Teinturier from the same locality received the same day. The must showed 25.9% of solid contents by spindle.

CHARBONO.

(See Vit. Rept. 1887–89, p. 83.)

This variety was at first planted with some confidence, but later was almost universally discarded. It has, however, some good qualities, which should recommend it for a few localities. It is very vigorous and productive, even on poor soils; bears with short-pruning, and is very free from any disease. The bearing is more regular if the vines are pruned half-long or allowed to extend themselves on trellis or horizontal wires. At Tulare, Amador, and Paso Robles it has been pruned half-long, and has proved one of the most prolific bearers, giving nearly ten tons per acre in the alkali soil of the first mentioned station, and three tons in the light, dry, hill soil of Amador foothill station. At Tulare it produces a good deal of second crop, which colors early and is therefore difficult to separate by unskilled hands. The second crop is, however, almost ripe when the first is ready for picking, and if picked with it, aids the fermentation.

In 1893 the vines bore at the rate of about nine tons per acre, and made a fair wine, which cleared quickly and kept well; it was lacking in smoothness and delicacy, the grapes having been made up with some second crop, and the large crop having prevented the development of its best qualities. In 1894 the crop was only about five tons per acre, and the wine made was proportionally superior. The wine at five months was bright, of good color, full flavor, smooth, and agreeable. The indications are that for bearing, color, and quality, this is one of the best varieties for red wine yet tested in Tulare.

The must has contained from 20% to 24% of sugar at all the stations except those near the bay where the solid contents have seldom exceeded 20%. The acid is somewhat low at the interior stations, but there is generally enough to insure a complete fermentation—at Tulare an average of 0.45%. Except at Paso Robles, the wine has always had good color, not of the brightest tint, but maintaining itself well and not turning yellow. It is generally deficient in tannin, and often in body, and, though generally agreeable at first, becomes flat and insipid in aging. It is not a wine to be kept long or used alone, but its productiveness, good color, and neutral character make it useful as a blend with astringent, light-colored wines. It is likely to be of use, however, only to those with whom quantity is more looked for than quality.

ANALYSES OF MUSTS AND WINES.

CHARBONO.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
							By Weight	By Volume		At Pressing	At Six Months	
1891—No. 1536.	Paso Robles	Oct. 6	24.15	------	.34	------	------	------	------	------	------	------
1892—No. 1623.	Tulare	Aug. 30	24.15	------	.44	------	------	------	------	------	------	------
No. 1730.	Paso Robles	Oct. 10	20.00	------	.51	------	------	------	------	------	------	------
1893—No. 1824.	Amador station	Sept. 8	19.30	------	.74	------	------	------	.320	.80	------	------
No. 1844.	Tulare	Sept. 14	20.85	18.84	.49	.48	7.64	9.54	.141	------	.49	3.2
No. 1934.	Paso Robles	Oct. 13	23.10	21.63	.48	.34	8.48	10.58	.218	.45	.41	3.1
1894—No. 2212.	Tulare	Sept. 26	24.40	------	.41	------	------	------	------	------	------	------
No. 2283.	Amador station	Oct. 4	24.80	24.12	.44	------	------	------	------	------	------	------

COLOR READINGS.

CHARBONO.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1893—No. 1824.	Amador station	80.0	VR-1VR	------	------	------	------	------	------	------	------	------	------
No. 1844.	Tulare	50.6	VR	31.7	VR	14.7	5VR	16.5	4VR	12.9	5VR	13.0	4VR
No. 1934.	Paso Robles	48.2	R	26.0	4VR	23.6	2VR	21.1	3VR	7.7	(Y)	7.0	(Y)

Record of Treatment.

No. 1536. *Charbono*, from Paso Robles station. A sample for must analysis was received October 8, 1890, in good condition. The bunches were very small, compact, with medium-sized berries. The grapes were mature. The must showed 24.15% of solid contents by spindle.

No. 1623. *Charbono*, from Tulare station. A sample for must analysis was received September 1, 1892, in good condition. The must showed 24.15% of solid contents by spindle.

No. 1730. *Charbono*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 20.0% of solid contents by spindle.

No. 1824. *Charbono*, from Amador station. A sample for must analysis and for color and tannin tests was received September 8, 1893, in good condition. The bunches were well filled with over-average sized berries, well colored, and with some flavor. The must showed 19.3% of solid contents by spindle.

No. 1844. *Charbono*, from Tulare station. Received September 14, 1893, in good condition, except for a few moldy bunches, which were easily picked out. The bunches were large to medium, well filled; the berries of good size, fairly well colored. There were many small, round bunches of second crop, which were nearly ripe, but much more acid than the others. The must showed 20.85% of solid contents by spindle. The temperature of the grapes at crushing was 69°, and the maximum reached was 95°, on the third day. The murk was nearly dry on the fourth day, and was drawn off on the fifth.

The wine was clear within a month, and promised well. At four months it was bright, possessed of some bouquet and flavor, full astringency and acid, but lacking in freshness. At seven months it had been racked twice, and was a wine of fair quality, but not quite clean-tasting.

No. 1934. *Charbono*, from Paso Robles station. Received October 13, 1893, in good condition. The bunches were small, cylindrical, close; the berries of medium size. The grapes were quite mature and with little acid. The must showed 23.1% of solid contents by spindle. The temperature of the must was 67° at crushing, and the maximum reached was 81°, on the third day. The murk was dry on the fifth day, when it was drawn off.

The wine was a little slow in clearing, and retained a little sweetness for over three months. At three months it was clear, full-bodied, with good aroma and flavor, low acid, very smooth and slightly sweet, but quite sound. At seven months it was quite dry and in good order. It had been racked twice, and was a good, clean-tasting wine of neutral character.

TANNAT.

(See Vit. Rept. 1883–85, p. 89; 1886, p. 72; 1887–89, p. 48.)

This variety has not been tested very extensively in California, but has many qualities to recommend it. It is a vigorous grower, generally shades its grapes well, and produces rather more freely than the Cabernets. It will bear with short-pruning in some places, but does better with long. The must is characterized by high sugar and acid. Its average composition for five years has been: at Cupertino, 26.2% of sugar and 0.82% of acid; at Mission San José, 26.1% of sugar and 0.62% of acid; at Tulare it lacks acid and the vines do not bear sufficiently; at the Amador station it is one of the best bearers, and has averaged 23.9% of sugar and 0.90% of acid. This is strongly corroborative of the opinion expressed in the Report for 1884, that the Tannat would be a valuable variety for the higher foothills of the upper part of the State. It has also done well at Paso Robles, bearing fairly well and producing a good wine with full acid, medium tannin, and somewhat higher body than is shown by the same variety in the bay counties; it also shows good and fairly stable color, but of a somewhat less pure violet-red tint.

ANALYSES OF MUSTS AND WINES.

TANNAT.		Date of Picking.	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric.	Ash	Alcohol. By Weight.	Alcohol. By Volume.	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—No. 1302.	Mission San José	Oct. 5	27.20	------	.63	.28	10.81	13.27	.237	.51	.39	3.50
No. 1389.	Cupertino	Oct. 18	25.00	------	.90	------	------	------	------	------	------	------
1891—No. 1523.	Mission San José	Oct. 1	26.40	------	.61	------	------	------	------	------	------	------
No. 1560.	Paso Robles	Oct. 7	23.25	------	.62	------	------	------	------	.63	------	------
1892—No. 1686.	Mission San José	Sept. 24	25.00	------	.72	------	------	------	------	------	------	------
No. 1761.	Paso Robles	Oct. 11	25.90	------	.57	------	9.34	11.64	.259	.59	.50	3.25
No. 1661.	Amador station	Sept. 16	24.85	------	.72	------	------	------	------	------	------	------
1893—No. 1835.	Amador station	Sept. 8	20.20	------	1.24	.24	------	------	.330	.88	------	------
No. 1911.	Paso Robles	Oct. 5	25.70	25.19	.71	.29	9.70	12.00	.259	.65	.59	3.30
No. 2079.	Mission San José	Nov. 2	26.20	------	.57	------	------	------	.240	.66	------	------
No. 2114.	Cupertino	Nov. 7	32.20	------	.75	------	------	------	.611	.71	------	------
1894—No. 2160.	Amador station	Sept. 17	26.50	------	.73	------	------	------	------	------	------	------
No. 2261.	Mission San José	Oct. 3	25.90	------	.56	------	------	------	------	.58	------	------
No. 2322.	Tulare	Oct. 13	27.20	------	.37	------	------	------	------	------	------	------

COLOR READINGS.

TANNAT.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1891—No. 1560.	Paso Robles	40.0	1VR	25.1	4VR	15.4	R	13.5	1R	15.2	3R	------	------
1892—No. 1761.	Paso Robles	121.0	VR	83.3	VR	38.4	1VR	42.5	1VR	41.2	1VR	34.7	2-3VR
1893—No. 1835.	Amador station	40.4	2VR	41.2	2VR	------	------	------	------	------	------	------	------
No. 1911.	Paso Robles	86.9	VR	57.1	1VR	41.2	1VR	36.4	2VR	28.6	2VR	25.5	3VR

RECORD OF TREATMENT.

No. 1302. *Tannat*, from Mission San José. Received October 7, 1890, in bad condition. The must showed 27.2% of solid contents by spindle. The grapes were fermented with No. 1303, Malbeck, in the proportion of 46 lbs. of the latter to 41 lbs. of Tannat. The fermentation lasted six days, commencing at a temperature of 66°, and attaining a maximum of 90°, on the third day.

The wine was clear in one month, but tasted and smelled of mold. It gradually improved, and at three months, after the second racking, it showed some good qualities: good flavor, some bouquet, full astringency and body, and medium acid; the moldiness was, however, still perceptible, and the lees showed a few lactic ferments; the wine was therefore pasteurized. Four months later it was bright, but a little flat. At fourteen months it had been racked four times, and was in good order, of good color and agreeable flavor, but the mold taste still persisted. At sixteen months it was bottled, but deteriorated in glass.

No. 1389. *Tannat*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 21, 1890, in poor condition, crushed and overripe. The must showed 25.0% of solid contents by spindle.

No. 1523. *Tannat*, from Mission San José. A sample for must analysis arrived October 1, 1891, in good condition. The must showed 26.4% of solid contents by spindle.

No. 1560. *Tannat*, from Paso Robles station. A sample for must analysis arrived October 8, 1891, in good condition. The bunches were medium sized and well filled, the grapes mature. The must showed 23.25% of solid contents by spindle.

No. 1686. *Tannat*, from Mission San José. Received September 27, 1892, in good condition. The must showed 25.0% of solid contents by spindle. The grapes were fermented with No. 1685, Chauché noir, from Mission San José.

No. 1761. *Tannat*, from Paso Robles station. Received October 14, 1892, in good condition. The must showed 25.9% of solid contents by spindle. The grapes were fermented with No. 1762 and No. 1763 in the following proportions: Tannat, 28 lbs.; Cabernet Franc, 22.5 lbs.; Gros Mansenc, 19 lbs.; that is to say, 40%, 32%, 28%, respectively. The temperature of the grapes at crushing was 63°, and the maximum arrived at was 80°, on the fourth day. The wine was dry in five days.

The wine cleared quickly, and at three months, having been racked once, it was bright, of good color, smooth, and generally pleasing. It improved in keeping, and at fourteen months was mature. At fifteen months it was bottled.

No. 1661. *Tannat*, from Amador station. A sample for must analysis arrived September 19, 1892, in poor condition. The must showed 24.85% of solid contents by spindle.

No. 1835. *Tannat*, from Amador station. A sample for must analysis and for color and tannin tests was received September 8, 1893, in good condition. The bunches were of good size, well filled, but showing here and there a little coulure. The must showed 20.2% of solid contents by spindle.

No. 1911. *Tannat*, from Paso Robles station. Received October 5, 1893, in good condition. The bunches and berries were small; the grapes were very sweet and somewhat past maturity. The must showed 25.7% of solid contents by spindle. The temperature at crushing was 66°, and the maximum arrived at was 85°, on the third day. The wine was dry on the fifth day.

At three weeks the wine was nearly clear and showed full acid and astringency. At three months it had been racked twice, and was clear, full-bodied, solid, of good flavor, but very rough. Four months later it had improved, developed a good bouquet, and was in general a very good wine.

No. 2079. *Tannat*, from Mission San José. A sample for must analysis and for color and tannin tests was received November 3, 1893, in good condition. The bunches were medium to small, cylindrical, with large shoulders or small wings, close below, looser near the peduncle; the berries were small and juicy. The must showed 26.2% of solid contents by spindle.

No. 2114. *Tannat*, from J. T. Doyle, Cupertino. A sample for must analysis and for color and tannin tests was received November 10, 1893, in good condition. The bunches were of medium to under medium size, conico-cylindrical, with one or two small wings, close; the berries small, commencing to shrivel, but with good acid. The must showed 32.2% of solid contents by spindle.

ST. MACAIRE.

(See Vit. Rept. 1887-89, p. 51.)

This variety is little known outside of the locality of the same name where it is cultivated in the Bordelais. It is a fairly vigorous vine, with good foliage, somewhat liable to *oidium* and coulure, but in good soils generally producing good crops—more abundant than the Tannat or Gros Mansenc. It requires long-pruning, and has produced at Tulare, when so pruned, an average of five tons to the acre. The must generally contains less sugar than that of the Tannat or Gros Mansenc, while in acid it is about between these. It ferments well, but the wine is not so robust a keeper as that of these two varieties. The wine has a remarkably intense color, being only exceeded by the Petit Bouschet.

The average composition of the must in ordinary years is: at Cupertino, 22.3% of sugar and 0.72% of acid; at Mission San José, 22.3% of sugar and 0.84% of acid; at Tulare, 23.0% of sugar and 0.53% of acid; at the Amador station, 24.2% of sugar and 0.86% of acid. The quality of the wine is distinctly inferior to that of the Tannat or of the Gros Mansenc, but it is more deeply colored and the vines bear more abundantly. It is thus useful as a color blend in localities where Gros Mansenc will not ripen, or for the production of a fair red wine of Claret type in localities like Tulare, where color is ordinarily lacking; it also serves to increase the acid in blends requiring it.

Analyses of Musts and Wines.

ST. MACAIRE.		Date of Picking	MUST.				WINES.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
							By Weight	By Volume		At Pressing	At Six Months	
1890—No. 1281.	Cupertino	Oct. 1	19.90	------	.99	.30	8.13	10.17	.294	.75	.53	3.08
No. 1295.	Mission San José	Oct. 1	21.95	------	.95	.20	8.98	11.18	.225	.77	.51	2.82
1891—No. 1443.	Tulare	Aug. 26	22.40	------	.50	------	------	------	------	------	------	------
No. 1515.	Mission San José	Sept. 30	22.15	21.96	1.07	------	10.81	13.27	.301	.92	.50	2.60
1892—No. 1678.	Tulare	Sept. 18	22.73	22.23	.38	.39	------	------	------	------	------	------
No. 1706.	Mission San José	Oct. 3	20.00	19.54	1.07	.35	8.06	10.08	.309	.86	.79	3.20
1893—No. 1827.	Amador station	Sept. 6	21.30	------	1.05	.21	------	------	------	------	------	------
No. 1846.	Tulare	Sept. 12	22.00	21.22	.74	.46	8.34	10.42	.259	.65	.52	3.30
No. 2063.	Mission San José	Nov. 1	24.80	24.34	.88	.32	9.56	11.91	.243	.80	.62	3.30
No. 2116.	Cupertino	Nov. 4	25.90	------	.66	------	------	------	.524	.77	------	------
1894—No. 2197.	Amador station	Sept. 23	27.15	------	.50	------	------	------	------	------	------	------
No. 2205.	Tulare	Sept. 27	24.80	------	.52	------	------	------	------	------	------	------
No. 2272.	Mission San José	Oct. 3	21.90	------	.70	------	------	------	------	------	------	------

Color Readings.

ST. MACAIRE.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1891—No. 1515.	Mission San José	444.0	2VR	190.0	1VR	125.0	2VR	133.3	2VR	108.0	2VR	69.0	2VR
1892—No. 1706.	Mission San José	222.0	VR	174.0	1VR	125.0	1VR	125.0	1VR	118.0	1VR	97.5	1-2VR
1893—No. 1846.	Tulare	138.0	VR	48.8	VR	38.8	1VR	36.0	1VR	31.0	2VR	30.3	2VR
No. 2063.	Mission San José	166.0	1-2VR	142.0	1VR	133.0	1-2VR	118.0	1-2VR	90.9	2VR	------	------
No. 2116.	Cupertino	148.0	VR	------	------	------	------	------	------	------	------	------	------

RECORD OF TREATMENT.

No. 1281. *St. Macaire*, from J. T. Doyle, Cupertino. Received October 3, 1890, in good condition but for a few moldy berries. The grapes were not mature. The must showed 19.9% of solid contents by spindle. The temperature of the grapes at crushing was 64°, and the maximum reached was 89°, on the fourth day. The fermentation lasted five days

The wine in about a month was of good quality, with full acid and astringency, but had a slight moldy taste. At three months the lees showed a little lactic filaments, but the taste was unaffected; the moldy taste was, however, still faintly perceptible. The wine was pasteurized at this date. Four months later the wine was bright and improved. At fourteen months it had been racked four times, and was in good condition and of good color; it was, however, rather flat and without much character. Some of the wine was bottled at sixteen months and some at twenty-three months. Two months after bottling the wines were tasted; the first bottled was flat and not good; the second, bright, smooth, and of good flavor, but lacking in bouquet.

No. 1295. *St. Macaire*, from Mission San José. Received October 3, 1890, in fair condition, some grapes moldy and not mature. The must showed 21.95% of solid contents by spindle. The temperature of the grapes at crushing was 68°, and the maximum temperature reached was 87°, on the second day. In three days and a half the fermentation was through, and the wine was pressed.

In three weeks the wine was nearly clear, but tasted of mold. The wine was somewhat slow in clearing, but it remained sound and no bad ferments were found in the lees. At three months the wine had been racked twice and was clear and showed some good qualities. It improved gradually, and finally at the end of fourteen months had almost lost its moldy taste, was well flavored, sound, and with high acid. At two years it was bottled. At two months after bottling the wine was of good quality but for a faint remnant of the moldy taste.

No. 1443. *St. Macaire*, from Tulare station. A sample for must analysis arrived August 29, 1891, in good condition. The must showed 22.4% of solid contents by spindle.

No. 1515. *St. Macaire*, from Mission San José. Received October 1, 1891, in good condition. The must showed 22.15% of solid contents by spindle. The temperature of the grapes at crushing was 65°, and the maximum temperature reached was 86°, on the third day. The murk was nearly dry on the morning of the third day, and was pressed in the afternoon of the same day.

In one month from crushing, the wine was clear, highly acid and astringent, and with good aroma; at three months it had developed a good vinous bouquet, was clean-tasting, of good flavor, and generally very promising. Tastings at five and at ten months showed a gradual improvement and good keeping qualities, in spite of the smallness of the sample (five gallons). At fifteen months the wine still retained its freshness. A month later it was bottled.

No. 1678. *St. Macaire*, from Tulare station. A sample for must analysis was received September 21, 1892, in good condition. The must showed 22.73% of solid contents by spindle.

No. 1706. *St. Macaire*, from Mission San José. Received October 5, 1892, in fair condition. The must showed 20.0% of solid contents by spindle. The temperature of the grapes at crushing was 69°, and the maximum, reached on the third day, was 88°. The murk had finished fermenting on the fourth day, and was pressed.

At three weeks after crushing the wine was clear and showed some good qualities, but had a little taste of mold. At three months it was bright, of good flavor, and with high acid and astringency. The wine remained good, but the acid continued rather harsh, and the moldy taste never quite disappeared. At eighteen months the wine was bottled.

No. 1827. *St. Macaire*, from Amador station. A sample for must analysis arrived September 8, 1893, in good condition. The bunches were of medium size and showed no coulure; the berries were of good size, not quite mature. The must showed 21.3% of solid contents by spindle.

No. 1846. *St. Macaire*, from Tulare station. Received September 15, 1893, in good condition. The bunches were of good size and loose; the berries of good size and well colored. The grapes were mature, and the must showed 22.0% of solid contents by spindle. The temperature of the grapes at crushing was 67°, and the maximum temperature of 88° was reached on the third day. The murk was nearly dry on the fourth day, and was pressed.

The wine was somewhat slow in clearing, and a nearly insensible fermentation continued for about a month. At the end of a month it was clear, but tasted flat. At three months it was bright, full-bodied, and astringent, but somewhat flat and not quite clean-tasting. At six months it had been racked twice, and was bright, but heavy and coarse.

No. 2063. *St. Macaire*, from Mission San José. Received November 1, 1893, in good condition. The bunches were of medium size, loose, irregularly conical, winged; the berries of medium size. The grapes were mature, and the must showed 24.8% of solid contents by spindle. The temperature of the grapes at crushing was 61°, and the maximum reached was 81°, on the fourth day. On the fifth day the murk was dry, and was pressed out.

At one month the wine was clear, and at three months bright, very rough, and full-bodied. At seven months it did not show very high quality, but was sound and very rich in color.

No. 2146. *St. Macaire*, from J. T. Doyle, Cupertino. A sample for must analysis and for color and tannin tests was received November 6, 1893, in good condition. The bunches were over medium in size, loose, irregular, branching; the berries of medium size, round, soft, thick-skinned, very ripe, but with good acid. The must showed 25.9% of solid contents by spindle.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF BORDEAUX TYPE.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At 6 to 8 Months	Body
	Cabernet Sauvignon.										
1248	Fresno	1890	22.40	21.80	.65	.32	------	------	------	------	------
1662	Amador station	1892	22.95	------	.57	------	------	------	------	------	------
1820	Amador station	1893	22.70	------	.80	.21	------	------	------	------	------
2282	Amador station	1894	25.45	23.61	.53	------	------	------	------	------	------
1342	Mission San José	1890	22.90	------	.62	.26	11.36	.252	------	.40	2.78
1591	Mission San José	1891	25.40	24.11	.44	------	------	------	------	------	------
1765	Mission San José	1892	21.95	21.22	.77	------	10.83	.199	.69	.63	2.85
1950	Mission San José	1893	22.10	------	.58	------	------	------	------	------	------
2303	Mission San José	1894	29.00	------	.47	------	------	------	------	------	------
1347	Cupertino	1890	24.80	------	.40	------	------	------	------	------	------
1554	Paso Robles	1891	25.65	------	.41	------	------	------	------	------	------
1750	Paso Robles	1892	24.80	------	.31	------	------	------	------	------	------
1914	Paso Robles	1893	24.80	25.19	.53	.23	11.64	------	------	.46	3.10
1892	Tulare	1893	23.70	20.99	.37	------	------	------	------	------	------
2207	Tulare	1894	25.50	24.12	.39	------	------	------	------	------	------
	Average, Amador station	------	**23.70**	**23.61**	**.63**	**.21**	------	------	------	------	------
	Average, Mission San Jose	------	**24.27**	**22.67**	**.57**	**.26**	**11.09**	**.225**	**.69**	**.52**	**2.82**
	Average, Paso Robles	------	------	**25.19**	**.42**	**.23**	**11.64**	------	------	**.46**	**3.10**
	Average, Tulare	------	**24.60**	**22.56**	**.38**	------	------	------	------	------	------
	Cabernet Franc.										
1522	Mission San José	1891	26.95	26.31	.44	------	------	------	------	------	------
2294	Mission San José	1894	23.20	------	.36	------	------	------	------	------	------
1559	Paso Robles	1891	23.50	------	.58	------	------	------	------	------	------
1762	Paso Robles	1892	22.85	------	.50	------	------	------	------	------	------
2070	Paso Robles	1893	26.70	25.76	.43	.30	12.36	.262	.49	.36	3.15
	Average, Mission San Jose	------	------	**26.31**	**.40**	------	------	------	------	------	------
	Average, Paso Robles	------	------	**25.76**	**.50**	**.30**	**12.36**	**.262**	**.49**	**.36**	**3.15**

	Merlot.										
1218	Fresno	1890	23.70		.28						
1366	Cupertino	1890	26.30		.38						
2060	Cupertino	1893	26.30		.51			.294	.74		
1380	Mission San José	1890	28.80		.40						
1586	Mission San José	1891	25.90	24.96	.36	.44					
1993	Mission San José	1893	25.90		.58			.451	.68		
2259	Mission San José	1894	23.70		.49						
1955	Paso Robles	1893	28.40	28.33	.29	.33		.326	.41		
	Average, Cupertino		**26.30**		**.44**			**.294**	**.74**		
	Average, Mission San Jose		**26.07**	**24.96**	**.46**	**.44**		**.451**	**.68**		
	Malbeck.										
1303	Mission San José	1890	24.55		.56	.38					
2274	Mission San José	1894	22.60		.50						
1321	Cupertino	1890	25.20		.53						
2055	Cupertino	1893	25.20		.62			.384	.90		
1475	Fresno	1891	25.00	24.64	.55	.51					
1489	Paso Robles	1891	28.80	29.07	.54						
1653	Paso Robles	1892	22.15	21.80	.53	.34					
1917	Paso Robles	1893	26.30	24.64	.50	.38	12.20	.272	.48	.44	3.30
1665	Amador station	1892	24.25		.58						
1817	Amador station	1893	21.50	20.99	.78	.26		.294	.72		
1679	Tulare	1892	22.80		.44						
1797	Tulare	1893	21.10	18.90	.62	.45	9.27	.298	.51	.67	3.80
2208	Tulare	1894	22.60		.53						
	Average, Mission San Jose		**23.58**		**.53**	**.38**					
	Average, Cupertino		**25.13**	**24.64**	**.57**	**.51**		**.384**	**.90**		
	Average, Paso Robles		**25.75**	**25.12**	**.52**	**.36**	**12.20**	**.272**	**.48**	**.44**	**3.30**
	Average, Amador station		**22.88**	**20.99**	**.68**	**.26**		**.294**	**.72**		
	Average, Tulare		**22.13**	**18.90**	**.53**	**.45**	**9.27**	**.298**	**.51**	**.67**	**3.80**
	Verdot.										
1223	Fresno	1890	23.70	23.62	.57	.33					
1250	Fresno	1890	24.10	23.62	.57	.27					
1331	Cupertino	1890	21.05		.92						
2043	Cupertino	1893	25.70		1.10			.355	.94		
2115	Cupertino	1893	26.30		1.15			.400	.79		
2124	Cupertino	1893	25.70		1.01						
1382	Mission San José	1890	25.00		.99	.23	12.36	.320		.39	3.32
1592	Mission San José	1891		24.11	.82	.40	11.91	.291	.67	.49	3.20
1991	Mission San José	1893	24.10		.92			.425	.85		
2306	Mission San José	1894	25.00		.64						
1551	Paso Robles	1891	23.40		.39						

SUMMARY OF ANALYSES OF MUSTS AND WINES OF BORDEAUX TYPE—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid (as Tartaric)	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric.		Body
									At Pressing	At 6 to 8 Months	
	Verdot—Continued.										
1726	Paso Robles	1892	25.90		.48						
1736	Paso Robles	1892	20.60		.53						
1935	Paso Robles	1893	26.95	26.24	.49	.31		.534	.41		
1681	Tulare	1892	23.70		.39						
1942	Tulare	1893	22.35	21.38	.63	.23		.438	.56		
2317	Tulare	1894	26.00		.47						
1828	Amador station	1893	21.50		1.23			.386	1.13		
	Average, Fresno		**23.90**	**23.62**	**.57**	**.30**					
	Average, Cupertino		**24.69**		**1.04**			**.377**	**.86**		
	Average, Mission San Jose		**24.52**		**.84**	**.32**	**12.13**	**.345**	**.76**	**.44**	**3.26**
	Average, Paso Robles			**26.24**	**.47**	**.31**		**.534**	**.41**		
	Average, Tulare		**24.02**	**21.38**	**.49**	**.23**		**.438**	**.56**		
	Gamai Teinturier.										
1228	Fresno	1890	25.40	25.76	.64	.40					
1276	Cupertino	1890	21.93		.80	.23	11.45	.202	.84	.52	2.58
2128	Cupertino	1893	26.50		.68			.349	.71		
1580	Mission San José	1891	26.80	26.99	.65		13.73	.307	.75	.50	2.70
1684	Mission San José	1892	24.10		.93		11.82	.232	.84	.86	3.10
1945	Mission San José	1893	23.20		.87			.428	.86		
2265	Mission San José	1894	25.65		.80						
1663	Amador station	1892	25.86		.58						
1823	Amador station	1893	20.20		.88			.253	1.00		
1866	Paso Robles	1893	23.05	20.99	.68	.24	10.58	.122	.56	.55	2.95
1893	Tulare	1893	26.90	24.12	.64	.40		.317	.71		
	Average, Cupertino		**24.22**		**.74**	**.23**	**11.45**	**.275**	**.78**	**.52**	**2.58**
	Average, Mission San Jose			**26.99**	**.81**		**12.78**	**.322**	**.82**	**.68**	**2.90**
	Average, Amador station		**23.03**		**.73**			**.253**	**1.00**		

	Teinturier.										
1205	Fresno	1890	24.55	21.43	.48	.54	11.64	.210	.46	.38	3.20
1235	Fresno	1890	22.00	21.80	.71	.43					
1283	Cupertino	1890	25.20		.70	.32	12.36	.359	.54	.32	3.28
2121	Cupertino	1893	26.10		.50			.531			
1292	Mission San José	1890	23.60		.80	.21	11.64	.310	.71	.37	2.78
1521	Mission San José	1891	25.90	25.19	.60		12.13	.311	.74	.59	3.05
1587	Mission San José	1891	27.55	26.99	.55						
1710	Mission San José	1892	25.00		.70	.32					
1946	Mission San José	1893	25.90		.85			.547	.83		
2271	Mission San José	1894	22.70		.53			.305			
1497	Paso Robles	1891	21.50	20.99	.57	.33	10.00	.100	.53	.53	3.05
1666	Amador station	1892	26.25		.56						
1831	Amador station	1893	23.70		.60			.361	.75		
2196	Amador station	1894	28.00		.33						
1943	Tulare	1893	23.45		.74						
2151	Tulare	1894	24.55		.57						
	Average, Fresno		**23.27**	**23.11**	**.59**	**.48**	**11.64**	**.210**	**.46**	**.38**	**3.20**
	Average, Cupertino		**25.65**		**.60**	**.32**	**12.36**	**.445**	**.54**	**.32**	**3.28**
	Average, Mission San Jose			**26.08**	**.67**	**.26**	**11.93**	**.310**	**.72**	**.48**	**2.91**
	Average, Amador station		**25.98**		**.49**			**.361**	**.75**		
	Average, Tulare		**24.00**		**.65**						
	Charbono.										
1536	Paso Robles	1891	24.15		.34						
1730	Paso Robles	1892	20.00		.51						
1934	Paso Robles	1893	23.10	21.63	.48	.34	10.58	.218	.45	.41	3.10
1623	Tulare	1892	24.15		.44						
1844	Tulare	1893	20.85	18.84	.49	.48	9.54	.141		.49	3.20
2212	Tulare	1894	24.40		.41						
1824	Amador station	1893	19.30		.74			.320	.80		
2283	Amador station	1894	24.80	24.12	.44						
	Average, Paso Robles		**22.42**	**21.63**	**.44**	**.34**	**10.58**	**.218**	**.45**	**.41**	**3.10**
	Average, Tulare		**23.13**	**18.84**	**.45**	**.48**	**9.54**	**.141**		**.49**	**3.20**
	Average, Amador station			**24.12**	**.59**			**.320**	**.80**		
	Tannat.										
1302	Mission San José	1890	27.20		.63	.28					
1523	Mission San José	1891	26.40		.61						
1686	Mission San José	1892	25.00		.72						
2079	Mission San José	1893	26.20		.57			.240	.66		
2261	Mission San José	1894	25.90		.56				.58		
1389	Cupertino	1890	25.00		.90						
2114	Cupertino	1893	32.20		.75			.611	.71		

SUMMARY OF ANALYSES OF MUSTS AND WINES OF BORDEAUX TYPE—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At 6 to 8 Months	Body
	Tannat—Continued.										
1560	Paso Robles	1891	23.25		.62				.63		
1761	Paso Robles	1892	25.90		.57						
1911	Paso Robles	1893	25.70	25.19	.71	.29	12.00	.259	.65	.59	3.30
1661	Amador station	1892	24.85		.72						
1835	Amador station	1893	20.20		1.24	.24		.330	.88		
2160	Amador station	1894	26.50		.73						
2322	Tulare	1894	27.20		.37						
	Average, Mission San Jose		**26.14**		**.62**	**.28**		**.240**	**.62**		
	Average, Cupertino		**33.60**		**.82**			**.611**	**.71**		
	Average, Paso Robles			**25.19**	**.67**	**.29**	**12.00**	**.259**	**.64**		**3.30**
	Average, Amador station		**23.85**		**.89**	**.24**		**.330**	**.88**		
	St. Macaire.										
1281	Cupertino	1890	19.90		.99	.30	10.17	.294	.75	.53	3.08
2116	Cupertino	1893	25.90		.66			.524	.77		
1295	Mission San José	1890	21.95		.95	.20	11.18	.225	.77	.51	2.82
1515	Mission San José	1891	22.15	21.96	1.07		13.27	.301	.92	.50	2.60
1706	Mission San José	1892	20.00	19.54	1.07	.35	10.08	.309	.86	.79	3.20
2063	Mission San José	1893	24.80	24.34	.88	.32	11.91	.243	.80	.62	3.30
2272	Mission San José	1894	21.90		.70						
1443	Tulare	1891	22.40		.50						
1678	Tulare	1892	22.73	22.23	.38	.39					
1846	Tulare	1893	22.00	21.22	.74	.46	10.42	.259	.65	.52	3.30
2205	Tulare	1894	24.80		.52						
1827	Amador station	1893	21.30		1.05	.21					
2197	Amador station	1894	27.15		.50						
	Average, Cupertino		**22.90**		**.82**	**.30**	**10.17**	**.409**	**.76**	**.53**	**3.08**
	Average, Mission San Jose			**24.34**	**.79**	**.32**	**11.91**	**.243**	**.80**	**.62**	**3.30**
	Average, Tulare		**22.98**	**21.72**	**.53**	**.43**	**10.42**	**.259**	**.65**	**.52**	**3.30**
	Average, Amador station										

RED RHENISH TYPE.

The most noted of the German red wines, the wines of Ingelheim and Asmannshausen, are the product of the Blaue Burgunder or Pinot, which have been discussed under the Burgundy varieties. The light wines of Affenthal are made from the Affenthaler or Blaue Arbst, and resemble the wines of Bordeaux more than those of Burgundy. The grapes contain only a moderate amount of sugar, and full acid. The wine is light and of good color.

There are two varieties known in Germany under the name of Affenthaler. The one growing at the stations seems to be that which goes also under the name of Blaue Arbst, and is superior to the other in all but bearing qualities. It is very promising for California, and makes a wine of high quality, less rough and less marked in aroma than that of the best Medoc varieties, but of excellent character, and of good fermenting and keeping qualities.

AFFENTHALER.

(See Vit. Rept. 1887-89, p. 86.)

Further experiments with the Affenthaler show it to be one of the varieties capable of producing a red wine of high quality in California. The vine, though bearing some superficial resemblance to the Pinot, is certainly not identical with any variety of Pinot, as is stated by some ampelographers; and still less with Trollinger, as stated by others. The character of the wine allies it much more closely with the Bordeaux varieties than with the Burgundy. The variety, as it grows in California, does not correspond perfectly with the descriptions in European works, but differs only in particulars which may be due to climatic causes. The following description is drawn from the vines growing in the Mission San José experimental plot: The leaves are of medium size, circular in outline, obtusely dentate with mucronate teeth alternately small and large; upper sinuses very shallow, lower none, petiolar sinus deep and narrow; the bunches are of medium size, conical, winged, well filled, but not compact; the berries are small, round, thin-skinned, juicy. At the Amador station the grapes have thicker skin, and at all the stations the leaves have much less indument than the European specimens are credited with.

The success of this variety at Fresno proves that the original habitat of a vine cannot always be taken as indicating infallibly the localities where it will be of use and where it will not. It did not bear heavily at Fresno, but it bore as well as any variety producing a wine of high quality. No. 1460, Affenthaler, from Fresno, was a wine of high body, astringency, and vinosity, with good flavor, color, and excellent keeping qualities. It was, perhaps, of higher quality than any wine made at this station from Fresno grapes. With 0.48% of acid the must averaged 24.80% of sugar, and fermented thoroughly and without difficulty. Unfortunately, the vine has not yet been tested at Tulare. At Mission San José and at Cupertino the Affenthaler has borne fairly well and has produced an excellent wine of good keeping qualities, slow to mature, less acid than the Italian varieties, but with greater delicacy. At Paso Robles the composition of the must has shown a slight deficiency in acid, and the vines have not borne well enough to allow of a winemaking test. At the Amador station the vine is a moderate grower and fair bearer, but has not yet been sufficiently tested.

ANALYSES OF MUSTS AND WINES.

AFFENTHALER.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
							By Weight	By Volume		At Pressing	At Six Months	
1890—No. 1237.	Fresno	Aug. 23	24.10	23.62	.48	.30	......	......	......	......	......	......
No. 1313.	Cupertino	Oct. 8	21.50	......	.62	.25	8.84	11.00	.229	.55	.36	2.70
No. 1417.	Mission San José	Oct. 28	25.50	......	.72	.22	11.31	13.82	.313	.70	.48	3.08
1891—No. 1460.	Fresno	Aug. 29	24.80	......	.48	......	9.70	12.09	.350	.54	.49	3.35
No. 1541.	Paso Robles	Oct. 6	25.00	......	.34	......	......	......	......	......	......	......
No. 1571.	Mission San José	Oct. 7	21.95	......	.77	......	......	......	......	.68	......	......
No. 1583.	Mission San José	Oct. 13	23.90	22.67	.63	......	9.56	11.91	.350	.68	.54	3.05
1892—No. 1646.	Paso Robles	Sept. 13	22.60	......	.73	......	......	......	......	......	......	......
No. 1757.	Paso Robles	Oct. 11	23.90	......	.42	......	......	......	......	......	......	......
No. 1793.	Mission San José	Oct. 18	22.60	......	.72	......	9.05	11.27	.212	......	.72	2.65
1893—No. 1804.	Amador station	Sept. 1	21.10	......	.93	......	......	......	......	......	......	......
No. 1885.	Paso Robles	Sept. 21	22.20	......	.39	......	......	......	......	......	......	......
No. 1984.	Mission San José	Oct. 19	24.80	23.91	.71	......	9.34	11.64	.290	.68	.66	3.10
No. 2132.	Cupertino	Nov. 1	26.30	......	.54	......	......	......	.365	......	......	......
1894—No. 2147.	Amador station	Sept. 13	26.50	......	.61	......	......	......	......	......	......	......
No. 2304.	Mission San José	Oct. 12	22.80	......	.56	......	......	......	.183	......	......	......

COLOR READINGS.

AFFENTHALER.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1891—No. 1460.	Fresno	24.7	4VR	22.2	5VR	12.4	1-2R	11.4	1R	14.3	R	12.3	1R
No. 1571.	Mission San José	93.0	VR	27.0	2VR	16.5	4VR	16.5	5VR	11.2	R	......	......
No. 1583.	Mission San José	108.0	VR-1VR	80.0	VR-1VR	66.6	1VR	40.0	1VR	40.8	1VR	......	......
1893—No. 1984.	Mission San José	86.9	VR	58.8	VR-1VR	50.6	1VR	46.0	1VR	36.0	2VR	29.8	3VR
No. 2132.	Cupertino	48.2	2VR	......	......	......	......	......	......	......	......	......	......
1894—No. 2304.	Mission San José	51.3	1-2VR	......	......	......	......	......	......	......	......	......	......

Record of Treatment.

No. 1277. *Affenthaler*, from Fresno. A sample for must analysis was received August 25, 1890, in good condition, and mature. The must showed 24.1% of solid contents by spindle and 0.48% of acid.

No. 1313. *Affenthaler*, from Cupertino. Received October 10, 1890, in good condition, and mature. The must showed 21.5% of solid contents by spindle and 0.62% of acid. The temperature of the 192 pounds crushed was 64°, and the maximum reached was 86°, on the fourth day. On the fifth day the wine was still a little sweet, and on the sixth day it was drawn off.

In three weeks the wine was clear, and showed high astringency. At six weeks an examination of the lees showed them to be sound, and the wine was bright, with some aroma and pleasant flavor, clean taste, and medium acid. At three months the lees were examined, and found to contain some *S. pastorianus* and a few acetic germs; the wine was bright, developing well, and was racked for the second time. At five and at six months the lees were examined again, and showed an increase of the *S. pastorianus* and still a little acetic taste; the wine was bright, with good flavor, and had developed a good bouquet, but was still rough. At eight months the lees showed no injurious ferments. At fifteen months the wine was bright, with good ruby color, rich bouquet and flavor, clean taste, and of high vinosity; it was a wine of high quality, and was mature. Two months later it was racked, and part put in bottle. The rest was bottled at twenty-three months. At three years and three months the wine bottled at seventeen months was bright, in first-class order, and of high quality; the wine bottled later had not kept so well.

No. 1417. *Affenthaler*, from Mission San José. Received October 30, 1890, in fair condition, and mature. The must showed 25.5% of solid contents by spindle and 0.72% of acid. The grapes (116 pounds) were crushed the day after arrival, at a temperature of 66°; reached a maximum of 87° on the third day. The wine was dry on the sixth day, when it was drawn off.

At one month the wine was clear, showed good flavor and aroma, medium acid, high astringency, was of good quality, and still slightly sweet. At three months a microscopical examination of the lees showed them to be sound, and the wine was racked for the second time. The wine was clear, with good bouquet and flavor—a very agreeable wine, but with a trace of sugar. At five months the lees showed a few filaments, and the wine was pasteurized. It was bright, but still a little sweet, and the taste was slightly affected by secondary fermentation. At eight months it was racked for the third time, and at twelve months had lost all its sweetness; it was clear, and still showed good quality, but it had deteriorated. It was bottled, but did not keep well in bottle.

No. 1460. *Affenthaler*, from Fresno. Received August 31, 1891, in good condition. The must showed 24.8% of solid contents by spindle and [illegible] of acid. The grapes weighed 50.25 pounds, and were crushed on the day they were received. The temperature of the must at crushing was 66° and the maximum of 82° was reached on the fifth day. The wine was still a little sweet on the eighth day, when it was drawn off.

At three weeks the wine was very rough and astringent, cloudy, but quite dry. At six weeks it was bright, with good aroma and full and pleasing flavor. At two months it was racked. At four months it was bright, a very good wine, much softened down, and nearly mature (there were only two gallons). Tastings at six and at eight months showed that the wine retained its good quality, and had improved. At eight months it was put in glass. At three years and a half it was bright, with well-settled deposit, lacking in bouquet, but of very good flavor, smooth, clean-tasting, and of good and sufficient color.

No. 1541. *Affenthaler*, from Paso Robles station. A sample for must analysis was received October 8, 1891, in fair condition. The grapes were thin-skinned, somewhat crushed, and mature. The must showed 25.0% of solid contents by spindle and 0.54% of acid.

No. 1571. *Affenthaler*, from Mission San José. A sample for must analysis and color test was received October 9, 1891, in good condition. The must showed 21.95% of solid contents by spindle and 0.77% of acid.

No. 1583. *Affenthaler*, from Mission San José. Received October 16, 1891, in fair condition. The must showed 23.9% of solid contents by spindle, and 0.57% of acid. There were 159 pounds, which were crushed at a temperature of 70°. The maximum temperature, reached on the third day, was 91°. On the fourth day the wine was dry, and was drawn off.

At one month the wine was clear, very rough, and showed some aroma. At five months it was bright, an excellent, very solid wine, but with little bouquet. At ten months it was racked for the third time. The lees were examined at one, four, and five months, but no unsound ferments were found. At sixteen months the wine was in good order, had developed some bouquet, was of good quality, but slightly bitter. At eighteen months it was racked, and part bottled; at twenty-two months the rest was bottled. At two years and four months the bottled wine was tasted; both bottlings were bright and of good color; that last bottled had been injured by remaining too long in a small keg; the second bottling was a full, generous wine, with some bouquet and of full flavor, but too rough and not aged enough in wood.

No. 1646. *Affenthaler*, from Paso Robles station. A sample for must analysis was received September 16, 1892, in good condition. The must showed 22.6% of solid contents by spindle and 0.73% of acid.

No. 1757. *Affenthaler*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 23.9% of solid contents by spindle and 0.43% of acid.

No. 1793. *Affenthaler*, from Mission San José. Received October 21, 1892, in poor condition. The must showed 22.6% of solid contents by spindle and 0.72% of acid. The 131.5 pounds were crushed at a temperature of 63°, and reached a maximum of 87° on the third day. The wine was nearly dry on the fourth day, and was drawn off on the fifth.

In one month the wine was clear, and was racked and taken to the cellar. At three months it was bright, clean-tasting, with high acid and astringency, some bouquet and flavor; in general, a very agreeable wine. At five months it was in good order, faintly sweet, but sound. It was racked for the second time, and at eight months was quite dry, but still raw. At ten months it was still very rough and astringent, but promising. Four months later it had improved, but was not mature. At eighteen months it was bottled.

No. 1804. *Affenthaler*, from Amador station. A sample for must analysis was received September 1, 1893, in good condition. The bunches were of medium size, compact; the berries small and thick-skinned. The must showed 21.1% of solid contents by spindle and 0.93% of acid.

No. 1885. *Affenthaler*, from Paso Robles station. A sample for must analysis was received September 21, 1893, in good condition. The bunches were small and loose; the berries soft, thin-skinned, with some flavor, and mature. The must showed 22.2% of solid contents by spindle and 0.39% of acid.

No. 1984. *Affenthaler*, from Mission San José. Received October 19, 1893, in good condition. The bunches were of medium size, conical, winged, well filled, but not compacted; the berries were small, round, thin-skinned, juicy, mature. The must showed 24.8% of solid contents by spindle and 0.71% of acid. The 115 pounds were crushed at a temperature of 60°, and attained a maximum of 88° on the third day. The wine was dry on the fifth day, and was drawn off on the sixth.

At one month the wine was clear, but extremely rough. It was racked and taken to the cellar, and at three months was bright, with very marked acid and astringency, full and agreeable bouquet and flavor, a wine of good promise. At four months it was racked for the second time, and at seven months it had improved, but was still very rough and showed excellent keeping qualities. At ten months the lees showed *S. pastorianus;* the wine was in good order, but still very rough. A month later it was racked and in part bottled. At sixteen months the wine was in good order, improved in bouquet and flavor, of clean taste, a full, rich wine, but not quite mature. A month later it was bottled.

No. 2132. *Affenthaler*, from Cupertino. A sample for must analysis was received November 3, 1893, in good condition. The bunches were small, conico-cylindrical, compact; the berries were small, shriveled, much overripe, but with a fresh taste. The must showed 26.3% of solid contents by spindle and 0.54% of acid.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF RED RHENISH TYPE.

Number	Locality.	Vintage of	Must.				Wine.				Body
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric.		
									At Pressing	At 6 to 8 Months	
	Affenthaler.										
1237	Fresno	1890	24.10	23.62	.48	.30					
1460	Fresno	1891	24.80		.48		12.09	.350	.54	.49	3.35
1313	Cupertino	1890	21.50		.62	.25	11.00	.229	.55	.36	2.70
2132	Cupertino	1893	26.30		.54			.365			
1417	Mission San José	1890	25.50		.72	.22	13.82	.313	.70	.48	3.08
1571	Mission San José	1891	21.95		.77				.68		
1583	Mission San José	1891	23.90	22.67	.63		11.91	.350	.68	.54	3.05
1793	Mission San José	1892	22.60		.72		11.27	.212		.72	2.65
1984	Mission San José	1893	24.80	23.91	.71		11.64	.290	.68	.66	3.10
2304	Mission San José	1894	22.80		.56			.183			
1541	Paso Robles	1891	25.00		.34						
1646	Paso Robles	1892	22.60		.73						
1757	Paso Robles	1892	23.90		.42						
1885	Paso Robles	1893	22.20		.39						
1804	Amador station	1893	21.10		.93						
2147	Amador station	1894	26.50		.61						
	Average, Fresno		**24.45**	**23.62**	**.48**	**.30**	**12.09**	**.350**	**.54**	**.49**	**3.35**
	Average, Cupertino		**23.90**		**.58**	**.25**	**11.00**	**.297**	**.55**	**.36**	**2.70**
	Average, Mission San Jose		**24.25**	**23.29**	**.63**	**.22**	**12.16**	**.269**	**.68**	**.60**	**2.97**
	Average, Paso Robles		**23.42**		**.47**						
	Average, Amador station		**23.85**		**.77**						

RED BURGUNDY TYPE.

(For further description, see Vit. Rept. 1887-89, p. 89.)

Notwithstanding the general failure of the Burgundy grapes proper (the Pinots) in California, there are some very good as well as some very bad wines which are sold here under the name of Burgundies. They have, however, very seldom much resemblance to the Burgundies of France, and in fact differ so much among themselves that there is not even a type of wine which could be called California Burgundy. The reason for the repeated failures to make and keep good Pinot wines is doubtless to be looked for in the lack of proper methods and care in fermentation. The Bordeaux and Italian varieties have given universally so much better results than those of Burgundy that the latter are being almost entirely abandoned; but with proper control of temperature, and exclusion of injurious germs during fermentation and the first months of keeping, we shall doubtless be able to make as good or better wines of the more delicate Pinots. It is very much to be desired that this should be done, for the American and English taste prefers, in general, the smooth Burgundy type to the somewhat harsher Clarets.

PINOTS.

(See Vit. Rept. 1885-86, p. 77; 1887-89, p. 90.)

The latest investigations of this group of grapes confirm the opinions expressed in the last Viticultural Report. Under the conditions of wine-making in California, it is next to impossible to make and keep a perfectly sound wine of Pinots alone. In some localities it is doubtless possible to make a Pinot wine of high quality and to age it, but only with a minute attention to detail and an elaborate care, which no price that is likely to be obtained at present would justify. The grapes would have to be picked at exactly the right degree of ripeness, handled with the greatest care to avoid breaking the berries, and then fermented and kept in a perfect cellar, where the conditions of temperature, ventilation, and cleanliness were under perfect control.

Nearly all the Pinot wines made at the experimental cellar have been injured by secondary fermentations, principally on account of the poor condition in which the grapes have been received, it being almost impossible to ship such delicate grapes without crushing them and allowing them to become attacked by injurious organisms, before they can be put into the fermenting-vat. For the hot interior localities the Pinots must be unhesitatingly rejected. In the cooler localities of the Coast Range they may be utilized by blending in the fermenting-vat with some more acid and more robust variety, such as the Gamai Teinturier, but with some sacrifice of their smooth Burgundy character. Their juice has entered into the composition of some of the best champagne wines made in this State.

ANALYSES OF MUSTS AND WINES.

PINOTS.		Varieties.	Date of Picking	MUST.				WINE.					
				Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
								By Weight	By Volume		At Pressing	At Six Months	
1890—No. 1219.	Fresno	Blauer Burgunder	Aug. 22	21.50	21.38	.69	.39						
No. 1224.	Fresno	Pinot de St. George	Aug. 22	25.00	25.19	.62	.55						
No. 1232.	Fresno	Blauer Burgunder	Aug. 23	25.40	24.64	.42	.38						
No. 1258.	Mission San José	Pinot (mixed)	Sept. 24	24.80		.65	.31	9.92	12.36	.102	.54	.38	3.10
No. 1325.	Cupertino	Franc Pinot	Oct. 11	26.30		.54							
No. 1332.	Cupertino	Pinot de St. George	Oct. 11	25.75		.81							
No. 1374.	Cupertino	P. Noirien	Oct. 14	27.80		.57							
No. 1392.	Cupertino	Blauer Burgunder	Oct. 19	29.70		.34							
1891—No. 1437.	Tulare	Blauer Burgunder	Aug. 24	23.60		.39							
No. 1484.	Paso Robles	Pinot de St. George	Sept. 1	19.70		.54							
No. 1506.	Mission San José	Franc Pinot	Sept. 27	25.00	24.64	.61							
No. 1508.	Mission San José	Pinot de St. George	Sept. 27	25.00	24.64	.53	.39						
No. 1588.	Mission San José	Blauer Burgunder	Oct. 14	28.00	28.32	.54							
1892—No. 1624.	Tulare	Pinot de St. George	Aug. 29	22.15		.37							
No. 1638.	Mission San José	"Pinots"	Sept. 10	22.70		.75		9.20	11.45	.189	.64	.63	2.70
No. 1744.	Paso Robles	Pinot de St. George	Oct. 11	21.10		.34							
1893—No. 1809.	Amador station	Franc Pinot	Sept. 1	23.30		.56				.230	.53		
No. 1819.	Amador station		Sept. 6	22.80	22.33	.53		9.05	11.27	.189	.49	.86	3.30
No. 1910.	Paso Robles	Pinot de St. George	Oct. 5	23.50	23.71	.41		7.99	10.00	.138	.44	.35	2.40
No. 2005.	Tulare	Pinot de St. George	Oct. 23	23.10	21.80	.32							
No. 2064.	Mission San José	Pinot de St. George	Nov. 2	28.60	27.65	.47				.262			
No. 2077.	Mission San José	Franc Pinot	Nov. 3	28.30	26.99	.48		10.81	13.27	.150	.61	.50	3.20
1894—No. 2263.	Mission San José	Pinot de St. George	Oct. 5	22.20		.74				.173			
	Pinot de Pernand.												
1890—No. 1226.	Fresno		Aug. 23	24.55	24.22	.54	.46						
No. 1367.	Cupertino		Oct. 14	25.90		.75							
1891—No. 1480.	Paso Robles		Sept. 1	21.30	17.70	.48							
No. 1504.	Mission San José		Sept. 24	24.55	23.62	.53	.32	9.63	12.09	.210	.50	.44	3.34
1892—No. 1702.	Tulare		Sept. 27	26.90		.39							
1893—No. 1799.	Tulare		Aug. 31	23.30		.67							

ANALYSES OF MUSTS AND WINES—Continued.

PINOTS.		Varieties.	Date of Picking	MUST.				WINE.					
				Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
Pinot de Pernand—Continued.													
1893—No. 1867.	Paso Robles		Sept. 15	22.60	20.61	.47	.31			.102			
1894—No. 2152.	Tulare		Sept. 17	22.60		.57							
No. 2270.	Mission San José		Oct. 5	25.20		.46				.175			

COLOR READINGS.

PINOTS.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.		Six Months.	
1892—No. 1638.	Mission San José	48.8	2VR	28.4	5VR	21.7	R	17.4	1R	17.6	1R	15.8	R	14.2	1R
1893—No. 1809.	Amador station	9.0	3R+Y	9.7	R+Y										
No. 1819.	Amador station	12.9	3VR+Y	16.3	VR+Y	12.1	(Y)	12.1	(Y)						
No. 1910.	Paso Robles	38.0	VR	9.6	R	9.3	R	8.3	R	3.8	3R+Y				
No. 2064.	Mission San José	35.7	5VR												
No. 2077.	Mission San José	26.3	4VR	18.1	R	15.0	R	13.3	R	5.9	Y				
1894—No. 2263.	Mission San José	19.1	1R												
Pinot de Pernand.															
1891—No. 1504.	Mission San José	37.0	5VR	19.2	5VR	14.1	1R	14.0	1R	14.6	3R				
1893—No. 1867.	Paso Robles	12.4	1R	10.3	3R										
1894—No. 2270.	Mission San José	52.0	1VR												

Record of Treatment.

No. 1219. *Blauer Burgunder*, from Fresno. A sample for must analysis was received August 25, 1890, in poor condition—crushed, overripe, and some of the berries dried. The must showed 21.5% of solid contents by spindle and 0.69% of acid.

No. 1224. *Pinot St. George*, from Fresno. A sample for must analysis was received August 25, 1890, in good condition, but overripe. The must showed 25.0% of solid contents by spindle and 0.62% of acid.

No. 1232. *Blauer Burgunder*, from Fresno. A sample for must analysis was received August 25, 1890, in good condition, but overripe, and with some dried berries. The must showed 25.4% of solid contents by spindle and 0.42% of acid.

No. 1258. *Pinots* (mixed), from Mission San José. Received September 26, 1890, in fair condition, but somewhat bruised on account of loose packing. The grapes were very unevenly ripened; most of the bunches were mature, but some were unripe. The must showed 24.8% of solid contents by spindle and 0.65% of acid. The grapes, which consisted of Pinot de Pernand, Pinot St. George, and Pinot Noirien, were crushed on the day after arrival and fermented with some Meunier in the proportion of: Pinots, 250 lbs., and Meunier, 84.5 lbs. The temperature of the must was 67°, and the maximum reached was 97°, on the fourth day. On the fifth day the murk was nearly dry, and was drawn off.

The wine remained cloudy, and fermented slightly for a month, though at the end of that time no sugar was perceptible to the taste. At two months the lees were well settled, and a microscopic examination showed no unsound ferments. At this stage the wine was clear, but still giving off carbonic gas; it was of medium acid, low astringency, and good body, had a bitter after-taste, and was undeveloped and flat. A week later it was racked for the second time, and at four months it was still clear, but had a suspicious smell. An examination of the lees showed filaments, so the wine was pasteurized. Three months after pasteurizing it was bright, the unpleasant odor had almost disappeared, and the wine was light, smooth, and of fair quality. Two months later it was racked again, and at fifteen months it was bright, of poor color and bouquet, of fair flavor, and quite mature. Two months later it was racked and part put in glass. At twenty-five months the rest was bottled. Both samples deteriorated in the bottles, on account of secondary fermentations.

No. 1325. *Franc Pinot*, from Cupertino. A sample for must analysis was received October 13, 1890, in fair condition and quite mature. The must showed 26.3% of solid contents by spindle and 0.54% of acid.

No. 1332. *Pinot St. George*, from Cupertino. A sample for must analysis was received October 13, 1890, in good condition, but with some dried grapes. The must showed 25.75% of solid contents by spindle and 0.81% of acid.

No. 1374. *Pinot Noirien*, from Cupertino. A sample for must analysis was received October 17, 1890, in fair condition, a few berries moldy and some dried. The must showed 27.8% per cent of solid contents by spindle and 0.57% of acid.

No. 1392. *Blauer Burgunder*, from Cupertino. A sample for must analysis was received October 21, 1890, in bad condition; some berries moldy, and many shriveled and overripe. The must showed 29.7% of solid contents by spindle and 0.34% of acid.

No. 1437. *Blauer Burgunder*, from Tulare station. A sample for must analysis was received August 27, 1891, in good condition. The must showed 23.6% of solid contents by spindle and 0.39% of acid.

No. 1484. *Pinot St. George*, from Paso Robles station. A sample for must analysis was received September 1, 1891, in good condition. The must showed 19.7% of solid contents by spindle and 0.54% of acid.

No. 1506. *Franc Pinot*, from Mission San José. Received September 27, 1891, in poor condition. The must showed 25.0% of solid contents by spindle and 0.61% of acid. The grapes were mixed with No. 1507, Meunier, and No. 1508, Pinot St. George, in the following proportions: Franc Pinot, 70 lbs.; Meunier, 59.5 lbs.; Pinot St. George, 45.25 lbs. The temperature of the grapes at crushing was 67°, and the maximum reached was 97°, on the third day. On the fourth day, when the murk was still a little sweet and fermenting slowly, it was drawn off.

At one month the wine was nearly clear, dry but flat, though somewhat better than the Pinot de Pernand. The lees were examined, and were apparently sound, but a month later the taste was a little suspicious and the wine was pasteurized for safety. It was then blended with No. 1504, Pinot de Pernand.

No. 1508. *Pinot St. George*, from Mission San José. Received September 27, 1891, in poor condition. The must showed 25.0% of solid contents by spindle, and 0.53% of acid. The grapes were mixed with No. 1506.

No. 1588. *Blauer Burgunder*, from Mission San José. A sample for must analysis was received October 16, 1891, in poor condition. The must showed 28.0% of solid contents by spindle, and 0.54% of acid.

No. 1624. *Pinot St. George*, from Tulare station. A sample for must analysis was received September 1, 1892, in good condition. The must showed 22.15% of solid contents by spindle and 0.37% of acid.

No. 1638. *Pinots*, from Mission San José. Received September 13, 1892, in good condition, but not quite mature. The must showed 22.7% of solid contents by spindle, and 0.75% of acid. The weight of grapes crushed was 310 lbs. The temperature at crushing was 64°, and the maximum, reached on the third day, 94°. On the sixth day the wine was quite dry, and was drawn off.

At one month the wine was racked and taken to the cellar; it was dry and nearly clear. At four months it was bright, of good bouquet and flavor, fruity, clean-tasting, and sound. A little later the lees were examined and showed a little acetic taint, but no filaments. Two months later the wine was in good condition; it had kept well, and was a very good wine, with full and pleasing flavor and bouquet. At eight months it had been racked twice, and had changed little from the last tasting. After this it deteriorated, and at fifteen months was bright and of fair quality, had kept well for a Pinot, but was a little flat. At nineteen months it was bottled. At three years and a half the bottled wine was bright and showed good quality, but was not quite clean-tasting.

No. 1744. *Pinot St. George*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 21.1% of solid contents by spindle and 0.35% of acid.

No. 1809. *Franc Pinot*, from Amador station. A sample for must analysis was received September 1, 1893, in fair condition; the grapes were small and unevenly ripened, many of them were abortive and green. The must showed 23.3% of solid contents by spindle and 0.56% of acid.

No. 1819. *Pinot*, from Amador station. A sample for must analysis was received September 8, 1893, in good condition. The bunches were small, cylindrical, compact; the berries thin-skinned and juicy. This sample was labeled Serine, but by mistake, as it was evidently a Pinot. The must showed 22.8% of solid contents by spindle and 0.53% of acid.

No. 1910. *Pinot St. George*, from Paso Robles station. Received October 5, 1893, in good condition. There were some bunches of another variety mixed with the sample. The Pinot had small bunches of very ripe and somewhat shriveled berries, the other variety had larger, firmer, and unshriveled berries. The must showed 23.5% of solid contents by spindle and 0.41% of acid. Fifty-nine pounds of grapes were crushed at a temperature of 66°. The maximum temperature reached was 82°, on the second day. The wine was dry on the fourth day, when it was drawn off.

In three weeks the wine was racked and taken to the cellar; it was nearly clear, but tasted flat. At three months it was clear, smooth, and well flavored, but lacked freshness; at four months it was racked for the second time. At seven months it had changed little; it was a fair wine, but not quite clean-tasting. At ten months it had improved, and was bright and sound, but very light in color. A month later, the quantity being so small, it was bottled.

No. 2005. *Pinot St. George*, from Tulare Station. A sample for must analysis was received October 23, 1893, in good condition. Some other grape was mixed with the Pinot. The Pinot had small, well-filled bunches of small berries, overripe, but not shriveled. The must showed 23.1% of solid contents by spindle and 0.32% of acid.

No. 2064. *Pinot St. George*, from Mission San José. A sample for must analysis was received October 31, 1893, in good condition. The bunches were small, regular, close, cylindrical, with a small wing; the berries were small, shriveled, overripe. The must showed 28.6% of solid contents by spindle and 0.47% of acid.

No. 2077. *Franc Pinot*, from Mission San José. Received November 3, 1893, in good condition. The bunches were small, compact, cylindrical, with a small shoulder; the berries were small, soft, commencing to shrivel, and much overripe. The must showed 28.3% of solid contents by spindle and 0.48% of acid. There were 89.5 lbs. crushed at a temperature of 67°. The maximum, reached on the fourth day, was 85°. The wine was nearly dry on the sixth day, when it was drawn off.

At one month, when the wine was racked and taken to the cellar, it was clear, but very bitter. At two months it was clear and of good flavor, but still bitter. After this it improved, but did not quite lose its bitterness. At ten months the wine was bottled, on account of the smallness of the sample.

No. 1226. *Pinot de Pernand*, from Fresno. A sample for must analysis was received August 25, 1890, in good condition, but overripe. The must showed 24.55% of solid contents by spindle and 0.54% of acid.

No. 1367. *Pinot de Pernand*, from Cupertino. A sample for must analysis was received October 17, 1890, in fair condition, but somewhat overripe and shriveled. The must showed 25.9% of solid contents by spindle and 0.75% of acid.

No. 1480. *Pinot de Pernand*, from Paso Robles. A sample for must analysis was received September 3, 1891, in good condition. The bunches were small; the berries were very small, not very sweet, but matured. The must showed 21.3% of solid contents by spindle and 0.48% of acid.

No. 1504. *Pinot de Pernand*, from Mission San José. Received September 27, 1891, in fair condition; a little mold. The must showed 24.55% of solid contents by spindle and 0.53% of acid. There were 101 lbs. of grapes crushed at a temperature of 67°; and the maximum temperature reached, on the third day, was 93°. On the fourth day the wine was still a little sweet and fermenting slowly, when it was drawn off.

At one month the wine was nearly clear, but tasted flat. At two months the lees showed a very few filaments and the wine tasted a little suspicious, so it was pasteurized and blended with No. 1506, Pinot from Mission San José. At six months the blend was clear, smooth, with some flavor and a little bouquet, low acid, medium astringency, fairly pleasing, but rather flat. It was racked for the third time, and again at eleven months. At seventeen months it showed improvement and had kept excellently. It was racked again at nineteen months and part bottled. At twenty-three months the rest was bottled. At three years and a half both wines were in first-class order, fresh and clean-tasting, and with excellent bouquet and full flavor. The earlier bottling was the better, was perfectly sound, and a wine of high character, the bouquet was remarkable, and the only fault it had was a slight greenness; the later bottling had a slight taint of acetic acid. Some of the wine bottled at eleven months had spoiled.

No. 1702. *Pinot de Pernand*, from Tulare station. A sample for must analysis was received September 29, 1892, overripe and badly shriveled. The must showed 26.9% of solid contents by spindle and 0.39% of acid.

No. 1799. *Pinot de Pernand*, from Tulare station. A sample for must analysis was received August 31, 1893, in good condition. The grapes were smaller than those of the average Pinot de Pernand, juicy, tasteless, the bunches well filled. The must showed 23.3% of solid contents by spindle and 0.67% of acid.

No. 1867. *Pinot de Pernand*, from Paso Robles station. A sample for must analysis was received September 15, 1893, in good condition. The grapes were mixed with a few bunches of Petit Sirah. The bunches were small, and the berries very sweet and overripe. The must showed 22.6% of solid contents by spindle and 0.57% of acid.

MEUNIER.

Synonyms: Müller traube; Miller grape.

Description.—More productive but less vigorous than the Franc Pinot; canes long, slender, trailing, often downy; young shoots very thickly covered with white down; leaves of medium size, round without sinuses, white downy on both sides, falling early; bunches small, close, short-cylindrical; berries small, round, on short pedicels, very juicy, and with rather thick skin.

The Meunier is simply one of the many variations of the ordinary Pinot. It is one of the most noticeable, on account of the abundance of white down with which it is covered. It bears rather better and is less liable to coulure and decay than the Franc Pinot, but otherwise the remarks under that variety apply equally to this.

ANALYSES OF MUSTS.

MEUNIER.		Date of Picking	MUST.				Tannin
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	
1890—No. 1212.	Fresno	Aug. 22	24.10	23.61	.41	.20	------
No. 1259.	Mission San José	Sept. 24	24.60	------	.57	.39	------
No. 1280.	Cupertino	Oct. 1	24.55	------	.53	.53	------
1891—No. 1507.	Mission San José	Sept. 24	25.85	25.76	.52	------	------
No. 1558.	Paso Robles	Oct. 4	22.15	------	.66	------	------
1892—No. 1691.	Tulare	Sept. 26	22.40	------	.30	------	------
No. 1746.	Paso Robles	Oct. 11	23.50	------	.39	------	------
1893—No. 1808.	Amador station	Sept. 1	23.70	------	.51	------	------
No. 2057.	Cupertino	Nov. 1	26.70	------	.69	------	.304
No. 2078.	Mission San José	Nov. 4	28.00	------	.45	------	.329
1894—No. 2267.	Mission San José	Oct. 5	28.00	------	.45	------	------
No. 2309.	Tulare	Oct. 10	23.70	------	.38	------	------

COLOR READINGS.

MEUNIER.	At Pressing.	
1893—No. 2057. Cupertino	40.0	2VR
No. 2078. Mission San José	33.6	4VR

RECORD OF TREATMENT.

No. 1212. *Meunier*, from Fresno. A sample for must analysis was received August 25, 1890, in fair condition; overripe and somewhat dried. The must showed 24.1% of solid contents by spindle and 0.41% of acid.

No. 1259. *Meunier*, from Mission San José. Received September 26, 1890, in poor condition, mature. The must showed 24.6% of solid contents by spindle and 0.57% of acid. The grapes were fermented with No. 1258, Pinot from Mission San José.

No. 1280. *Meunier*, from Cupertino. A sample for must analysis was received October 2, 1890, in fair condition. The bunches were of fair size; the berries overripe and commencing to dry up. The must showed 24.55% of solid contents by spindle and 0.53% of acid.

No. 1507. *Meunier*, from Mission San José. Received September 27, 1891, in poor condition. The must showed 25.85% of solid contents by spindle and 0.52% of acid. The grapes were fermented with No. 1506, Franc Pinot.

No. 1558. *Meunier*, from Paso Robles. A sample for must analysis was received October 8, 1891, in good condition. The bunches were small and compact; the berries small and round and much firmer than is usual with Meunier. The grapes were mature, and the must showed 22.15% of solid contents by spindle and 0.66% of acid.

No. 1691. *Meunier*, from Tulare station. A sample for must analysis was received September 29, 1892, in good condition. The must showed 22.4% of solid contents by spindle and 0.30% of acid.

No. 1746. *Meunier*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 23.5% of solid contents by spindle and 0.39% of acid.

No. 1808. *Meunier*, from Amador station. A sample for must analysis was received September 1, 1893, in fair condition. The grapes were small and unevenly ripened. The must showed 23.7% of solid contents by spindle and 0.51% of acid.

No. 2057. *Meunier*, from Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were under medium size, conico-cylindrical, close; the berries small, half-dried, over-mature. The must showed 26.7% of solid contents by spindle and 0.69% of acid.

No. 2078. *Meunier*, from Mission San José. A sample for must analysis was received November 3, 1893, in fair condition, much overripe, and the berries dried up. The must showed 28.0% of solid contents by spindle and 0.45% of acid.

ROBIN NOIR.

(See Vit. Rept. 1885–86, p. 69; 1887–89, p. 108.)

The results of the tests made of this variety at the newer stations are not such as to encourage its planting in the warmer sections of the State. At Tulare the must attains high sugar contents, but is lacking in acid, and the vines expend their strength principally on the second crop. At Paso Robles the vines bear better, but the wine is not of high quality and lacks tannin. At the Amador station the vine is a moderate grower and good bearer when pruned half-long, the grapes are well flavored and with fair color; they have not yet been tested as to their wine-making qualities, but they retain fair acid with a high percentage of sugar.

ANALYSES OF MUSTS AND WINES.

ROBIN NOIR.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
							By Weight	By Volume		At Pressing	At Six Months	
1890—No. 1230.	Fresno	Aug. 23	27.45	28.33	.43	.22						
No. 1284.	Cupertino	Oct. 1	21.50		.81							
No. 1428.	Mission San José	Oct. 28	24.45		1.05							
1892—No. 1694.	Tulare	Sept. 26	24.80		.34							
No. 1792.	Mission San José	Oct. 21	22.50		.91							
1893—No. 1807.	Amador station	Sept. 1	21.75		.93							
No. 1953.	Paso Robles	Oct. 15	23.70	22.23	.58	.30	9.70	12.09	.147	.60	.41	2.60
No. 1971.	Tulare	Oct. 15	24.45	24.64	.45	.51						
1894—No. 2199.	Amador station	Sept. 25	28.40		.48							
No. 2301.	Mission San José	Oct. 12	22.10		.71							
No. 2336.	Tulare	Oct. 19	27.80		.34							

COLOR READINGS.

ROBIN NOIR.		At Pressing.		One Month.		Two Months.		Three Months.	
1893—No. 1953.	Paso Robles	12.1	1R	6.8	2R	8.9	3R	4.7	1VR+Y

RECORD OF TREATMENT.

No. 1230. *Robin noir*, from Fresno. A sample for must analysis was received August 25, 1890, in good condition, but somewhat dried and over-mature. The must showed 27.45% of solid contents by spindle and 0.43% of acid.

No. 1284. *Robin noir*, from Cupertino. A sample for must analysis was received October 3, 1890, in good condition. The must showed 21.5% of solid contents by spindle and 0.81% of acid.

No. 1428. *Robin noir*, from Mission San José. A sample for must analysis was received October 30, 1890, in fair condition and mature. The must showed 24.45% of solid contents by spindle and 1.05% of acid.

No. 1694. *Robin noir*, from Tulare station. A sample for must analysis was received September 29, 1892, in good condition. The must showed 24.8% of solid contents by spindle and 0.34% of acid.

No. 1792. *Robin noir*, from Mission San José. Received October 21, 1892, in poor condition. The must showed 22.5% of solid contents by spindle and 0.91% of acid. The grapes were crushed and fermented with No. 1791, Carignane, from Mission San José.

No. 1807. *Robin noir*, from Amador station. A sample for must analysis was received September 1, 1893, in good condition. The bunches were well filled, the berries small, hard, and tasteless. The must showed 21.75% of solid contents by spindle and 0.93% of acid.

No. 1953 *Robin noir*, from Paso Robles station. Received October 15, 1893, in fair condition. The bunches were of over medium size, irregularly conical, very compact, the lower ends turned to one side; the berries were of medium size, round, thick-skinned, juicy, fresh-tasting, but with little flavor, mature. The must showed 23.7% of solid contents by spindle and 0.58% of acid. The 107 lbs. crushed were started at a temperature of 64°, and reached a maximum of 85° on the third day. The wine was dry on the fourth day, and was drawn off on the fifth.

At one month the wine was nearly clear, very astringent, with little color and good flavor. At three months it was racked for the second time; it was clear, and showed good quality, but still retained a slight sweetness, and was not quite clean-tasting. It remained sub-sweet for some time, but finally became dry, and at ten months was of fair quality; it was racked for the third time, and part put in bottle. At sixteen months it was in good order, dry, with little color, somewhat "éventé." Three weeks later it was bottled.

No. 1971. *Robin noir*, from Tulare station. A sample for must analysis was received October 16, 1893, in good condition. The bunches were very small, conical, compact; the berries small, nearly round, very thick-skinned, soft, juicy, with full acid, but little color. The grapes had the appearance of second crop. The must showed 24.45% of solid contents by spindle and 0.45% of acid.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF BURGUNDY TYPE (RED).

Number	Locality.	Vintage of	Must.				Wine.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric.		Body
									At Pressing	At 6 to 8 Months	
	Pinots.										
1219	Fresno	1890	21.50	21.38	.69	.39					
1224	Fresno	1890	25.00	25.19	.62	.55					
1232	Fresno	1890	25.40	24.64	.42	.38					
1258	Mission San José	1890	24.80		.65	.31					
1506	Mission San José	1891	25.00	24.64	.61						
1508	Mission San José	1891	25.00	24.64	.53	.39					
1588	Mission San José	1891	28.00	28.32	.54						
1638	Mission San José	1892	22.70		.75		11.45	.189	.64	.63	2.70
2064	Mission San José	1893	28.60	27.65	.47			.262			
2077	Mission San José	1893	28.30	26.99	.48		13.27	.150	.61	.50	3.20
2263	Mission San José	1894	22.20		.74			.173			
1325	Cupertino	1890	26.30		.54						
1332	Cupertino	1890	25.75		.81						
1374	Cupertino	1890	27.80		.57						
1392	Cupertino	1890	29.70		.34						
1437	Tulare	1891	23.60		.39						
1624	Tulare	1892	22.15		.37						
2005	Tulare	1893	23.10	21.80	.32						
1484	Paso Robles	1891	19.70		.54						
1744	Paso Robles	1892	21.10		.34						
1910	Paso Robles	1893	23.50	23.71	.41		10.00	.138	.44	.35	2.40
1809	Amador station	1893	23.30		.56			.230	.53		
1819	Amador station	1893	22.80	22.33	.53		11.27	.189	.49	.86	3.30
	Average, Fresno		**23.97**	**23.74**	**.58**	**.44**					
	Average, Mission San Jose		**25.57**	**26.45**	**.59**	**.35**					
	Average, Cupertino		**21.91**		**.45**						
	Average, Tulare		**22.95**	**21.80**	**.36**						
	Average, Paso Robles		**21.43**	**23.71**	**.43**		**10.00**	**.138**	**.44**	**.35**	**2.40**
	Average, Amador station		**23.05**	**22.33**	**.55**		**11.27**	**.109**	**.51**	**.86**	**3.30**

SUMMARY OF ANALYSES OF MUSTS AND WINES OF BURGUNDY TYPE (RED)—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At 6 to 8 Months	Body
	Pinot de Pernand.										
1226	Fresno	1890	24.55	24.22	.54	.46	------	------	------	------	------
1367	Cupertino	1890	25.90	------	.75	------	------	------	------	------	------
1480	Paso Robles	1891	21.30	17.70	.48	------	------	------	------	------	------
1867	Paso Robles	1893	22.60	20.61	.47	.31	------	.102	------	------	------
1504	Mission San José	1891	24.55	23.62	.53	.32	------	------	------	------	------
2270	Mission San José	1894	25.20	------	.46	------	------	.175	------	------	------
1702	Tulare	1892	26.90	------	.39	------	------	------	------	------	------
1799	Tulare	1893	23.30	------	.67	------	------	------	------	------	------
2152	Tulare	1894	22.60	------	.57	------	------	------	------	------	------
	Average, Paso Robles	------	**21.95**	**19.16**	**.48**	**.31**	------	**.102**	------	------	------
	Average, Mission San Jose	------	**24.88**	**23.62**	**.49**	**.32**	------	**.175**	------	------	------
	Average, Tulare	------	**24.27**	------	**.54**	------	------	------	------	------	------
	Meunier.										
1212	Fresno	1890	24.10	23.61	.41	.20	------	------	------	------	------
1259	Mission San José	1890	24.60	------	.57	.39	------	------	------	------	------
1507	Mission San José	1891	25.85	25.76	.52	------	------	------	------	------	------
2078	Mission San José	1893	28.00	------	.45	------	------	.329	------	------	------
2267	Mission San José	1894	28.00	------	.45	------	------	------	------	------	------
1280	Cupertino	1890	24.55	------	.53	.53	------	------	------	------	------
2057	Cupertino	1893	26.70	------	.69	------	------	.304	------	------	------
1558	Paso Robles	1891	22.15	------	.66	------	------	------	------	------	------
1746	Paso Robles	1892	23.50	------	.39	------	------	------	------	------	------
1691	Tulare	1892	22.40	------	.30	------	------	------	------	------	------
2309	Tulare	1894	23.70	------	.38	------	------	------	------	------	------
1808	Amador station	1893	23.70	------	.51	------	------	------	------	------	------
	Average, Mission San Jose	------	**26.61**	**25.76**	**.49**	**.39**	------	**.329**	------	------	------
	Average, Cupertino	------	**25.62**	------	**.61**	**.53**	------	**.304**	------	------	------
	Average, Paso Robles	------	**22.88**	------	**.53**	------	------	------	------	------	------
	Average, Tulare	------	**23.05**	------	**.34**	------	------	------	------	------	------

	Robin noir.										
1230	Fresno	1890	27.45	28.33	.43	.22					
1284	Cupertino	1890	21.50		.81						
1428	Mission San José	1890	24.45		1.05						
1792	Mission San José	1892	22.50		.91						
2301	Mission San José	1894	22.10		.71						
1694	Tulare	1892	24.80		.34						
1971	Tulare	1893	24.45	24.64	.45	.51					
2336	Tulare	1894	27.80		.34						
1807	Amador station	1893	21.75		.93						
2199	Amador station	1894	28.40		.48						
1953	Paso Robles	1893	23.70	22.23	.58	.30	12.09	.147	.60	.41	2.60
	Average, Mission San Jose		**23.02**		**.89**						
	Average, Tulare		**25.68**	**24.64**	**.38**						
	Average, Amador station		**25.08**		**.70**						

JURA TYPE.

There is a class of full-bodied, deep-colored wines, of good and even high character, which are produced at various places in the region of the Rhone from the slopes of the Jura Mountains to the vineyards of the Hermitage. These wines differ markedly from the delicate Burgundies to the north, and equally from the neutral and rancio red wines to the south. They resemble to some extent the Medocs, but are heavier than the Clarets of commerce. They may be considered as holding an intermediate position between the Medoc wines and those of northern Italy. Wines made from Petite Sirah, Mondeuse, and César are of this type, and reach their highest development in the first growth of the Hermitage, made principally from Petite Sirah. The Beclan makes a wine of smoother and more neutral character, which is used to modify the occasionally excessive asperity of the above grapes. Though grown in connection with the grapes of this type, it has been placed among the Southern French, on account of the different character of its wine.

The *Petite Sirah* and *Mondeuse* are the varieties included in this type which have shown the highest quality in California. The former has been largely abandoned, on account of its poor bearing qualities; but the Mondeuse is deserving of a much more extended place in our vineyards than it has at present. It is a remarkably regular and fairly abundant bearer; it unites quality and abundance in as high a degree as perhaps any other red grape yet tried. It is especially adapted to the coast counties wherever the ripening is not too late.

One of the most valuable grapes of this category, though not properly belonging to the group, is the *Tinta Valdepeñas*. A really excellent wine has been made from it at Tulare; a somewhat surprising result, considering the climate and the nature of the soil where it was grown. For rich valley soils in the hotter districts probably no better choice could be made with the object of producing dry red wines. Some of the Italian varieties approach it in adaptability to these conditions, but none so far tried surpass it in the quality of their products.

SIRAH.

(See Vit. Rept. 1883–85, p. 101; 1885–86, p. 83; 1887–89, p. 177.)

But for its liability to coulure in certain localities, there would doubtless have been a much more extended planting of Petite Sirah than there has been. At Mission San José and in parts of Napa and Sonoma it has given excellent results. From Oakville and Mission San José it is reported as producing four tons per acre with short-pruning. In the Livermore Valley and in parts of Napa, it has been much less satisfactory, and no system of pruning seems to be capable of combating its tendency to drop its fruit. The remedy seems to be, as pointed out in the last report, to choose cuttings from fruitful vines only, as there seem to be forms or variations of the variety more subject to coulure than others. The form cultivated at the stations under the name of Serine sets its fruit and bears much better than the form cultivated under the name of Sirah.

At Tulare the vine has shown itself a good grower, with plenty of foliage, and bears from three to four tons per acre with long-pruning.

The wine produced there has some character, fair color, good body, and medium acid and astringency; it is not adapted to use alone, as it does not keep very well and drops its color. It is useful, however, to blend with an acid wine of less character and color.

The grapes received from Paso Robles in good condition have had an average composition of 24.4% of sugar and 0.55% of acid, and have given a wine of fair quality, good body and astringency, and good, stable color. At Amador station the vine grows fairly well and bears about two and a half tons per acre, but goes a good deal to second crop, and gives a must low in acid. The average composition of the must has been at Cupertino 26.2% of sugar and 0.52% of acid, and at Mission San José, where it has been most successful, 25.2% of sugar and 0.72% of acid. At the latter place it has made uniformly an excellent wine of full body and astringency, of good acid and quality; it is also an excellent keeper.

Analyses of Musts and Wines.

SIRAH.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
							By Weight	By Volume		At Pressing	At Six Months	
1890—No. 1242.	Fresno	Aug. 1	25.10	24.11	.43	.37	9.92	12.36	.244	.30	.48	2.70
No. 1278.	Cupertino	Oct. 1	24.15	......	.67	......	......	......	......	......	......	......
No. 1296.	Mission San José	Oct. 1	25.30	......	.84	.22	9.99	12.46	.259	.71	.45	3.45
No. 1341.	Mission San José	Oct. 11	25.40	......	.64	.19	10.54	13.00	.301	.44	.38	3.32
No. 1370.	Cupertino	Oct. 14	24.15	......	.52	......	......	......	......	......	......	......
1891—No. 1438.	Tulare	Aug. 24	25.65	......	.37	......	......	......	......	......	......	......
No. 1472.	Fresno	Aug. 28	25.20	......	.48	......	9.92	12.36	.240	.51	.43	3.35
No. 1488	Paso Robles	Sept. 12	23.70	......	.50	......	......	......	......	......	......	......
No. 1492.	Paso Robles	Sept. 13	24.80	......	.53	......	......	......	......	......	......	......
No. 1564.	Mission San José	Oct. 6	27.35	......	.65	......	12.39	15.20	.411	.71	.43	3.20
1892—No. 1616.	Tulare	Aug. 26	23.70	22.23	.43	.30	8.48	10.58	.192	.32	.46	3.90
No. 1635.	Tulare	Sept. 4	25.10	......	.41	......	......	......	......	......	......	......
No. 1647.	Paso Robles	Sept. 13	23.95	......	.69	......	......	......	......	......	......	......
No. 1664.	Amador station	Sept. 16	26.40	......	.42	......	......	......	......	......	......	......
No. 1708.	Mission San José	Oct. 3	23.25	23.13	.78	.35	9.27	11.55	.335	.83	.70	2.95
1893—No. 1814.	Tulare	Sept. 1	22.40	21.80	.62	.50	8.27	10.36	.141	.47	.51	3.20
No. 1879.	Paso Robles	Sept. 15	22.60	20.99	.53	.43	......	......	.237	.46	......	......
No. 1895.	Paso Robles	Sept. 28	25.85	25.53	.51	.37	9.92	12.36	.211	.51	.50	3.30
No. 1952.	Mission San José	Oct. 14	24.60	......	.94	......	......	......	.345	.77	......	......
No. 2044.	Cupertino	Nov. 1	28.60	......	.58	......	......	......	.502	......	......	......
No. 2052.	Cupertino	Oct. 31	28.20	......	.58	......	......	......	.553	.79	......	......
No. 2076.	Mission San José	Nov. 3	28.80	25.65	.63	.30	10.91	13.36	.256	.65	.67	3.30
1894—No. 2139.	Tulare	Sept. 10	21.50	20.83	.65	......	8.84	11.00	.159	.58	.44	2.85
No. 2153.	Tulare	Sept. 17	24.00	......	.53	......	......	......	......	......	......	......
No. 2254.	Mission San José	Oct. 5	23.70	......	.64	......	......	......	.236	......	......	......
No. 2269.	Mission San José	Oct. 5	23.70	......	.68	......	......	......	.245	......	......	......
No. 2286.	Amador station	Oct. 6	23.50	......	.48	......	......	......	......	......	......	......

Color Readings.

SIRAH.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.		Six Months.	
1890—No. 1341.	Mission San José														
1891—No. 1472.	Fresno	47.0	2VR	25.0	5VR	14.9	2VR+Y	15.2	1VR+Y	15.2	4VR+Y	13.8	1VR+Y		
No. 1564.	Mission San José	149.0	VR	81.6	1VR	97.6	1-2VR	61.0	1-2VR	66.6	2VR				
1892—No. 1616.	Tulare	16.0	R	11.4	1R	10.5	2R	10.7	3R	12.5	3R	11.4	3R	11.1	3R
No. 1708.	Mission San José	285.0	VR	166.0	VR	103.0	2VR	80.0	2VR	74.2	2VR	70.2	2VR		
1893—No. 1814.	Tulare	14.1	1VR+Y	8.5	2VR+Y	5.5	(Y)								
No. 1879.	Paso Robles	66.6	VR	41.6	VR										
No. 1895.	Paso Robles	70.2	VR	40.0	2VR	26.4	2VR	25.2	2VR	21.7	3VR	21.6	4VR		
No. 1952.	Mission San José	143.0	VR												
No. 2044.	Cupertino	114.0	VR												
No. 2052.	Cupertino	103.0	1VR												
No. 2076.	Mission San José	129.0	VR-1VR	103.0	1VR	90.9	2VR	85.1	2VR	40.8	3VR				
1894—No. 2139.	Tulare	30.0	2VR	7.1	1R										
No. 2254.	Mission San José	88.8	VR												
No. 2269.	Mission San José	85.1	VR												

Record of Treatment.

No. 1242. *Petite Sirah*, from Margherita Vineyard, Fresno. Received August 2, 1890, in fairly good condition. Berries somewhat small for the variety, maturity complete. The must showed 25.1% of solid contents by spindle. The temperature of the must at crushing was 67°, and the maximum reached was 91°, on the third day. The murk was still a little sweet on the fifth day, when it was drawn off.

The wine continued to ferment slowly, and remained cloudy for over six weeks after pressing. At nine weeks it was clear, without bouquet, with little flavor, full tannin, and medium acid. At this date it was pasteurized, as the lees showed some lactic germs, though the taste was as yet unaffected. At eight months the wine had been racked three times, and was bright, improved in flavor, had developed a little bouquet, but was still harsh. It continued to improve up to the age of about fourteen months, at which date it was nearly mature and quite sound. It was bottled at nineteen and twenty-four months. At a little over three years both wines were tasted, and that first bottled was found to be the better. Both wines were of fair quality, of good flavor and body, but without bouquet and not quite clean-tasting.

No. 1278. *Petite Sirah*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 2, 1890, in good condition. The bunches were loose and with many small berries. The must showed 24.15% of solid contents by spindle.

No. 1296. *Petite Sirah*, from Mission San José. Received October 3, 1890, in good condition. The berries were rather small and many of them abortive. The must showed 25.3% of solid contents by spindle. The temperature of the must was 68° at crushing, and the highest temperature reached was 89°, on the third day. The murk was nearly dry on the fourth day, and was drawn off on the fifth.

The wine was nearly clear within three weeks from pressing. At two months it was quite clear, with full and pleasing flavor, good acid and astringency, but aroma somewhat masked by a slight moldiness. At three months the lees showed a few lactic ferments, and the wine was pasteurized. At seven months it was bright and much improved, full flavored, and of good quality. It kept remarkably well, considering the small size of the sample, and at fourteen months was a wine of high quality, in excellent condition, and with good bouquet and rich flavor. At sixteen months it was bottled.

No. 1341. *Serine*, from Mission San José. Received October 14, 1890, in bad condition, many of the bunches moldy. The must showed 25.4% of solid contents by spindle. The temperature of the grapes at crushing was 67°, and the maximum reached was 92°, on the fourth day. The murk was nearly dry on the fifth day, and was drawn off on the sixth.

In three weeks the wine was clear, still a little sweet, and highly astringent. At three months it was bright, full flavored, with good body, high astringency and alcohol, medium acid, and in general a good wine. The lees showed a few lactic ferments, and the wine was pasteurized, though the taste was still unaffected. The wine remained a little flat for some time, but gradually improved up to the time it was bottled, at sixteen months. At three years the bottled wine was bright, highly flavored, full-bodied, and generally of high quality, but not quite clean-tasting.

No. 1370. *Serine*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 17, 1890, in good condition, but overripe. The must showed 24.15% of solid contents by spindle.

No. 1438. *Serine*, from Tulare. A sample for must analysis was received August 27, 1891, in good condition. The must showed 25.65% of solid contents by spindle.

No. 1472. *Serine*, from Margherita Vineyard, Fresno. Received August 31, 1891, in good condition. The must showed 25.2% of solid contents by spindle. The temperature of the must at crushing was 68°, and the maximum reached was 83°, on the third day. The murk was nearly dry on the seventh day, when it was drawn off.

The wine remained slightly sweet for two or three weeks after pressing, but at five weeks was clear and dry. At six weeks it was clear, full-bodied and well flavored, but with a suspicious taste. The lees showed a few lactic ferments, and the wine was pasteurized. At four months it had improved, had developed some bouquet, but still tasted a little flat. It was racked four times during the first year, and successive tastings showed a gradual improvement up to the time it was bottled at sixteen months, when it was bright, with some bouquet and flavor, sound and clean-tasting. At three years and a half the wine was bright, of fair color, good bouquet and flavor; a very agreeable wine of more character than the Mourastel, but not quite so clean-tasting.

No. 1492. *Petite Sirah*, from Paso Robles station. A sample for must analysis was received September 16, 1891, in good condition, small, and mature. The must showed 24.8% of solid contents by spindle.

No. 1564. *Serine*, from Mission San José. Received October 9, 1891, in fair condition. The must showed 27.35% of solid contents by spindle. The temperature of the must at crushing was 60° and the maximum reached was 87°, on the fourth day. The murk was nearly dry on the sixth day, and was drawn off on the seventh.

At six weeks the wine was clear, with some aroma and full flavor, medium acid, and high astringency. At four months it was bright and of very good quality, showing no defect but a slight bitterness. At five months the wine was full-bodied and very good, with a slight sub-sweetness, but quite sound. It was racked three times during the first year, and remained in good order and developed well up to the time it was bottled at sixteen months.

No. 1616. *Serine*, from Tulare station. Received August 29, 1892, in good condition, and mature; there were a few small, abortive, green berries. The must showed 23.7% of solid contents by spindle. The temperature of the grapes at crushing was 65°, and the maximum reached was 96°, on the sixth day. The murk was not dry till the eighth day, when it was pressed.

This sample was fermented with No. 1617, Mondeuse, from Tulare, in the proportion of 72% of Serine to 28% of Mondeuse. In one month from pressing, the wine was clear, sound, and dry, but tasted a little flat. At four months it was bright, had good flavor, but the odor was not good, and the after-taste slightly bitter. The lees showed some filaments, so the wine was pasteurized. Two months after this the wine was racked; it had improved a little, but was not quite clean-tasting; its color was fairly good for a Tulare wine. It was bottled at nineteen months.

No. 1635. *Petite Sirah*, from Tulare station. A sample for must analysis was received September 6, 1892, in good condition. The must showed 25.1% of solid contents by spindle.

No. 1647. *Serine*, from Paso Robles station. A sample for must analysis was received September 16, 1892, in good condition. The must showed 23.95% of solid contents by spindle.

No. 1664. *Serine*, from Amador foothill station. A sample for must analysis was received September 19, 1892, in poor condition. The must showed 26.4% of solid contents by spindle.

No. 1708. *Serine*, from Mission San José. Received October 5, 1892, in fair condition. The must showed 23.25% of solid contents by spindle. The temperature of the grapes at crushing was 68°, and the maximum reached was 91°, on the third day. The murk was dry on the fourth day, and was drawn off on the fifth.

In three weeks the wine was clear and of good promise. At three months it was bright, of full, rich flavor, smooth, and of high quality. At five months it had improved, its acid and astringency being very marked. At this date it was racked for the second time. It remained bright and in good order, retaining its good quality till it was bottled at eighteen months.

No. 1814. *Serine*, from Tulare station. Received September 1, 1893, in fair condition, a few grapes moldy. The bunches were compact, the berries small and without flavor. The must showed 22.4% of solid contents by spindle. The temperature of the grapes at crushing was 65°, and the maximum reached was 92°, on the fifth day. The murk was dry on the fifth day, when it was drawn off.

In three weeks the wine was clear, and was racked and taken to the cellar. At five months it was clear and sound, but flat and of poor quality. At this date it was racked for the second time. At seven months it had improved somewhat, but was not fresh-tasting.

No. 1879. *Petite Sirah*, from Paso Robles station. Received September 15, 1893, in good condition. The bunches were loose and small, the berries small and well flavored, and mature. The must showed 22.6% of solid contents by spindle. The sample was used for must analysis and for color and tannin tests.

No. 1895. *Serine*, from Paso Robles station. Received September 28, 1893, somewhat crushed, but otherwise in good condition. The bunches were of good size, not compact; the berries of good size, well colored, and mature. The must showed 25.85% of solid contents by spindle. The temperature of the must was 66° at crushing; the maximum temperature reached was 87°, on the fourth day. The murk was dry on the sixth day, when it was drawn off.

The wine was somewhat slow in clearing, and was at first excessively rough. At two months it was nearly clear, highly flavored, and of full body. At four months it was clear, agreeably flavored, and smoother, but with a slightly bitter after-taste. At five months it was racked for the second time. At eight months it had improved, but was not quite clean-tasting.

No. 1952. *Petite Sirah*, from Mission San José. Received October 14, 1893, in poor condition, having been too long on the road. The bunches were of good size, irregular, well filled, but not compact. The grapes were well flavored, and the must showed 24.6% of solid contents by spindle. The sample was used for must analysis and for color and tannin tests.

No. 2044. *Petite Sirah*, from J. T. Doyle, Cupertino. A sample for must analysis and for color and tannin tests was received October 31, 1893, in good condition. The bunches were under medium size, conico-cylindrical, loose, much coulured; the berries were small, oval, much shriveled, overripe. The must showed 28.6% of solid contents by spindle.

No. 2052. *Serine*, from J. T. Doyle, Cupertino. A sample for must analysis and for color and tannin tests was received October 31, 1893, in good condition. The bunches were of medium size, long, conico-cylindrical, loose, but little coulured; the berries were small, commencing to shrivel, but with good acid. The must showed 28.2% of solid contents by spindle.

No. 2076. *Serine*, from Mission San José. Received November 3, 1893, in good condition. The bunches were under medium size, long, conico-cylindrical, with or without a small wing, loose; the berries were small, firm, but not crisp or pulpy, oval, very sweet, overripe. The must showed 28.8% of solid contents by spindle. The temperature of the grapes at crushing was 67°, and the maximum temperature reached was 87°, on the third day. The murk was still sweet on the sixth day, when it was drawn off.

In one month from crushing the wine was clear and dry. In two months it was bright, full-bodied, with dense color, full astringency, medium acid, and good flavor. At six months it was in excellent condition, still rough, but sound and with solid keeping qualities.

MONDEUSE.

(See Vit. Rept. 1883–85, p. 102; 1885–86, p. 83; 1887–89, p. 186.)

The latest experiments with the Mondeuse have confirmed the opinions expressed in former reports, and also the reputation the variety has in Europe, viz., that in suitable localities it will produce good crops, making full-bodied wines of good color, character, and keeping qualities, but in other localities its wine is thin and not of high quality. At the Mission San José station the vines have borne well, but the wine has been somewhat unsatisfactory, lacking in body and vinosity, though of good flavor. In the vineyard of Mr. McIver, of Mission San José, it has done better, but its best qualities are brought out in Napa and Sonoma, where it produces a wine of good body, color, and excellent keeping qualities. In Napa it is said to produce four to five tons to the acre with short-pruning; it also bears well in the Santa Clara Valley with short-pruning, but is occasionally subject to coulure.

At Tulare the vine is not a very strong grower, and though it sometimes bears good crops it is liable to coulure. The must is rather low in acid (average 22% of sugar and 0.42% of acid), but makes a good wine as regards tannin, color, and character. It makes a red wine of more vinosity and quality than perhaps any other grape at Tulare, but somewhat lacking in body. At the Amador station it has not borne well and has been subject to coulure. At Paso Robles it has succeeded better; but it has not yet been sufficiently tested there.

ANALYSES OF MUSTS AND WINES.

MONDEUSE.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—No. 1312.	Cupertino	Oct. 6	20.40	------	.79	.21	7.78	9.73	.237	------	.45	2.70
No. 1334.	Mission San José	Oct. 11	21.70	------	.76	.21	8.84	11.00	.294	.58	.50	2.58
1891—No. 1563.	Mission San José	Oct. 6	22.15	------	.68	------	8.91	11.09	.259	.77	.53	2.30
No. 1582.	Mission San José	Oct. 13	22.60	22.22	.53	------	9.20	11.45	.272	.68	.43	2.70
No. 1595.	Kenwood, Sonoma County	Oct. 16	23.70	22.22	.48	.33	9.78	12.18	.375	.58	.50	3.35
1892—No. 1617.	Tulare	Aug. 26	22.30	21.80	------	.35	------	------	------	------	------	------
No. 1729.	Paso Robles	Oct. 1	22.05	------	.47	------	------	------	------	------	------	------
No. 1764.	Mission San José	Oct. 12	19.75	19.54	.72	------	7.78	9.73	.256	.84	.74	2.60
1893—No. 1888.	Tulare	Sept. 22	20.20	19.08	.45	.31	7.78	9.73	.256	.53	.46	2.30
No. 1922.	Paso Robles	Oct. 12	22.60	21.38	.45	.30	8.20	10.25	195	.53	.70	3.30
No. 2037.	Cupertino	Nov. 1	23.10	------	.69	------	------	------	.432	.98	------	------
No. 2062.	Mission San José	Nov. 1	22.60	21.40	.65	.21	8.27	10.36	.301	.74	.62	2.60
1894—No 2174.	Amador station	Sept. 24	21.50	------	.56	------	------	------	------	------	------	------
No. 2206.	Tulare	Sept. 27	23.60	------	.47	------	------	------	------	------	------	------
No. 2216.	Paso Robles	Sept. 28	22.30	------	.53	------	------	------	------	------	------	------
No. 2264.	Mission San José	Oct. 5	20.50	------	.57	------	------	------	.203	------	------	------

COLOR READINGS.

MONDEUSE.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.		Six Months.	
1891—No. 1563.	Mission San José	------		65.5	1VR	42.5	2VR	26.8	3VR	27.0	4VR	------		------	
No. 1582.	Mission San José	90.9	1VR	52.0	1VR	42.5	1VR	37.3	1VR	27.7	4VR	------		------	
No. 1595.	Kenwood, Sonoma County	88.8	1VR	66.6	2VR	45.9	3VR	47.6	4VR	38.0	5VR	------		------	
1892—No. 1764.	Mission San José	111.0	2VR	108.0	2VR	38.8	2VR	33.9	1VR	29.2	1VR	32.0	1VR	16.0	3VR
1893—No. 1888.	Tulare	28.4	1VR	30.8	1VR	17.4	2VR	14.0	3VR	14.0	4VR	13.1	5VR	------	
No. 1922.	Paso Robles	121.0	VR	38.0	1VR	37.4	1VR	38.0	2VR	27.2	3VR	29.4	3VR	------	
No. 2037.	Cupertino	50.6	1-2VR	------		------		------		------		------		------	
No. 2062.	Mission San José	93.0	VR-1VR	48.2	1VR	50.0	1-2VR	50.0	1-2VR	------		------		------	
1894—No. 2264.	Mission San José	76.9	VR	------		------		------		------		------		------	

RECORD OF TREATMENT.

No. 1312. *Mondeuse*, from J. T. Doyle, Cupertino. Received October 10, 1890, in good condition, and mature. The must showed 20.4% of solid contents by spindle. The temperature of the grapes at crushing was 62°, and the maximum reached was 79°, on the fifth day. The murk was drawn off on the sixth day, when it was nearly dry.

At one month the wine was clear and showed high acid and astringency. At two months it was racked, and at three it had a light bouquet, good flavor, clean taste; was rough but promising. The lees showed some unsound ferments, so the wine was pasteurized. At seven months the wine was bright, improved in bouquet and flavor, smoother, and maturing well. At fifteen months it was in good condition, very fresh and clean-tasting, and nearly mature. It was bottled, part at seventeen and part at twenty-three months. At three years the wine first bottled was bright, very pleasant, smooth, and clean-tasting. The second bottling had not kept well.

No. 1334. *Mondeuse*, from Mission San José. Received October 14, 1890, in good condition, and mature. The must showed 21.7% of solid contents by spindle. The temperature of the grapes at crushing was 68°, and the maximum reached was 92°, on the fourth day. On the fifth day the murk was nearly dry, and on the sixth was drawn off.

In three weeks the wine was clear, but very raw-tasting. At six weeks it showed marked flavor and aroma, clean taste, full acid and tannin, and, in general, good quality. In three months it had progressed well, its bouquet and flavor were good, and it tasted quite sound, though the lees showed a few filaments. It was pasteurized for safety. Two months after pasteurizing it was in good condition, showed good acid and body, and was aging well. At nine months it was racked for the third time. At fifteen months it was very bright, had excellent color, and was generally good but for a slight odor of butyric acid. It was bottled at twenty-six months. At three years the wine in bottle was bright, smooth, and agreeable, but not quite clean-tasting.

No. 1563. *Mondeuse*, from Mission San José. Received October 9, 1891, in good condition, and mature; some of the grapes were shriveled. The must showed 22.15% of solid contents by spindle. The temperature of the must at crushing was 60°, and the maximum reached was 85°, on the fourth day. The murk was dry on the fifth day, when it was drawn off.

At five weeks the wine was bright, full-flavored, and showed high acid and astringency. It remained bright, was racked twice during the first ten months, developed some bouquet, but was somewhat harsh. The lees showed a good deal of *S. pastorianus.* The wine continued sound, and improved much in aging. It was bottled, part at sixteen and part at twenty-one months. At three years the wine bottled at ten months was bright, of good color, bouquet, and flavor, but a little raw; at sixteen months it was better, clean-tasting, and of high flavor; at twenty months not quite so good as at sixteen months. The wine was rather thin and lacking in body.

No. 1582. *Mondeuse*, from Mission San José. Received October 16, 1891, in fair condition. The must showed 22.6% of solid contents by spindle. The temperature of the grapes at crushing was 68°, and the maximum attained was 85°, on the third day. The murk was dry on the fourth day, when it was drawn off.

In one month the wine was clear, with full and pleasing flavor, some aroma, good astringency and acid. At two months it was bright and in good order. It remained bright, and the lees developed much *S. pastorianus.* At eight months the wine was bright, very smooth, and pleasing, with high bouquet, and maturing quickly. It was racked for the second time at ten months. At fifteen months it was in excellent order, and nearly mature. A month later it was bottled. At three years the bottled wine was bright and of good bouquet and flavor, but a little lacking in color and body. Blended with No. 1582, a full-bodied, heavy-colored Alicante Bouschet, it was much improved.

No. 1595. *Mondeuse*, from A. Macartney, Los Guilicos, Sonoma County. Received October 19, 1891, in good condition, but a little past maturity. The must showed 23.7% of solid contents by spindle. The temperature of the grapes at crushing was 64°, and the maximum reached was 82°, on the third day. The murk was drawn off on the fourth day while still sweet. It was dry on the eighth day.

In one month the wine was clear, possessed of good flavor and some aroma; it was very rough, with high astringency. It was racked at two months, and at five was bright, a full-bodied, well-rounded wine in excellent order. It was racked again at eight months, and remained bright, maintaining its high quality. At fifteen months it was in first-class condition, with excellent bouquet and flavor, and had kept perfectly in spite of the smallness of the sample (two gallons). At this date it was bottled. At three years the bottled wine was bright, with good color and bouquet, excellent flavor, and clean taste; an extremely good wine of high body, full but pleasing acid and astringency, and high vinosity.

No. 1617. *Mondeuse*, from Tulare station. Received August 29, 1892, in good condition, and mature. The must showed 22.3% of solid contents by spindle. This sample was fermented with No. 1616, Serine, from Tulare.

No. 1729. *Mondeuse*, from Paso Robles station. A sample for must analysis was received October 3, 1892, in good condition. The must showed 22.05% of solid contents by spindle.

No. 1764. *Mondeuse*, from Mission San José. Received October 15, 1892, in good condition. The must showed 19.75% of solid contents by spindle. The temperature of the grapes at crushing was 58°, and the maximum reached was 85°, on the fourth day. The murk was still a little sweet on the fifth day, and was drawn off on the sixth.

The wine was not very prompt in clearing, but was nearly clear at one month, when it was racked. At three months it was bright, with high acid and astringency, raw but promising. It remained harsh and green for some time, but continued sound, and developed some bouquet. At fourteen months it had somewhat softened down and possessed a light and delicate bouquet; it was, however, still a little harsh and not quite mature. It was bottled at eighteen months.

No. 1888. *Mondeuse*, from Tulare station. Received September 22, 1893, in good condition. The bunches were large and well filled; the berries were of medium size, juicy, soft, mature, the skin very astringent. The must showed 20.2% of solid contents by spindle. The temperature of the grapes at crushing was 65°, and the highest temperature reached was 83°, on the second day. The murk was still a little sweet on the fourth day, and was drawn off on the fifth.

In three weeks it was clear, and was then racked and taken to the cellar. In four months it was bright, well flavored, with some bouquet, high astringency, adequate acid—a clean-tasting, good wine, one of the best of the Tulare red wines. At six months it had been racked twice, and remained bright, sound, fresh, and agreeable.

No. 1922. *Mondeuse*, from Paso Robles station. Received October 12, 1893, in good condition. The bunches were irregular, loose, rather small; the berries small. The grapes were mature and some of them dried. The must showed 22.6% of solid contents by spindle. The temperature of the grapes at crushing was 69°. The fermentation lasted five days, and was cool, owing to the small size of the sample.

In three weeks the wine was clear, of good flavor, with moderate acid and pleasing astringency. It soon became bright, and at seven months was an agreeable wine, in excellent condition, but a little green.

No. 2037. *Mondeuse*, from J. T. Doyle, Cupertino. A sample for must analysis and for color and tannin tests was received October 31, 1893, in good condition. The bunches were over medium in size, long conical, close, with small wings; the berries were of medium size, somewhat shriveled, but fresh-tasting and with abundant acid. The must showed 23.1% of solid contents by spindle.

No. 2062. *Mondeuse*, from Mission San José. Received November 1, 1893, in good condition. The bunches were of medium size, conical, shouldered or with small wings, loose but well filled; the berries were of medium size, very slightly oval, juicy, well flavored, and the skin very astringent. The must showed 22.6% of solid contents by spindle. The temperature of the grapes at crushing was 62°, and the maximum reached was 85°, on the fourth day. The murk was dry on the fifth day, and was drawn off on the sixth.

In three weeks the wine was nearly clear, and was racked and taken to the cellar. At three months it was bright, well flavored, clean-tasting, with good acid and astringency—an excellent wine but for a slight moldy color. At six months it had been racked twice, and was in good condition and showed improvement.

CÉSAR.

Synonyms: Romain; Picarniau.

Description.—Vine vigorous and productive; canes strong, semi-erect, with long joints; leaves of medium size, wrinkled, glabrous above, tomentose below, five-lobed, with open sinuses; bunches over average size, close, conico-cylindrical, with strong peduncles; berries of medium size, round, with thick skin, and firm but juicy flesh.

The César is rather widely cultivated in the Auxerrois, where it is considered the most valuable variety next to the Pinots. In character it is much more nearly allied to the Mondeuse and Sirah than to the Pinots, and is therefore put in this group. Its wine is not of such high quality as that of the Franc Pinot, but is much esteemed, and when grown on hillsides is of good body and color. On low or very rich soils the vine runs too much to wood, and coulures. This tendency can be combated to some extent by training on trellis with long arms and short-pruning. On hillsides it bears well with ordinary short-pruning. This variety has been tested to such a limited extent in California that little can be said as to its adaptability. Its wine is of very different character from that of the Pinots, being highly astringent and deeply colored. The only sample made at the station did not keep very well, but that is to be accounted for by the overripe and crushed condition of the grapes when they arrived.

Analysis of No. 1594, César, from Kenwood.

Must—	
Solid contents by spindle	26.50%
Sugar by copper test	26.31
Acid as tartaric	.50
Ash	.37
Wine—	
Alcohol by volume	13.54
Acid at pressing	.50
Acid at six months	.40
Tannin	.544
Body	3.35

Color Readings.

At pressing	222.0	VR
At one month	88.8	1VR
At two months	72.0	1VR
At three months	68.0	2VR
At four months	51.2	2VR

Record of Treatment.

No. 1594. *César*, from A. Macartney, Kenwood, Sonoma County. Received October 19, 1891, in fair condition, a little crushed and moldy, somewhat past maturity, many of the grapes being dried up. The bunches were over average in size, conico-cylindrical, sparingly winged, not compact, but well filled with round, well-colored and medium-sized berries. The must showed 26.5% of solid contents by spindle and 0.50% of acid. The temperature of the grapes at crushing was 64°, and the maximum reached was 97°, on the fourth day. The wine was drawn off on the fifth day, while still sweet and fermenting. On the eighth day it was dry.

At one month the wine was not quite clear, was full-bodied and of high astringency, and with still a suspicion of sugar. At two months it was bright, with little bouquet, full flavor, and very good but for a taste of dried grapes. The wine was racked, and two months later it showed signs of some secondary fermentation. At one year the wine was good, except for some bitterness caused by secondary fermentation. At twenty-two months it was bottled. Eighteen months after bottling the wine was clear, of deep color, heavy body, a very full, rich wine, but injured by secondary fermentation.

ETRAIRE DE L'ADHUI.

This grape is considered by some authorities as a distinct variety from the Persan, and by others as simply an improved variation obtained by selection. It is extensively cultivated in the valley of L'Isère, where it is said to be vigorous, hardy, and fertile. It is especially suited to hills, and requires short-pruning. The wine is noted for its good body and excellent keeping qualities. It is generally fermented with one tenth of some white grape to improve its delicacy and vinosity. One of the most valued attributes of this variety is its almost perfect resistance to the mildew (*Peronospora*). So far, this variety has not sustained its European reputation as a prolific bearer at any of the stations. The analyses of the musts, however, indicate that its characteristic robustness is not lost here. It is noticeable for the full amount of acid which it maintains with high sugar; No. 1395, from Cupertino, with 29% of sugar and 1.15% of acid, is remarkable. The wine has sufficient color, nearly equal to that of the Mondeuse. The wines of these two varieties are said to be very similar in France; here the indications are that the Etraire would make a somewhat heavier wine than the Mondeuse.

ANALYSES OF MUSTS AND WINES.

ETRAIRE DE L'ADHUI.	Date of Picking	MUST.				WINE.	
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Tannin	Total Acid as Tartaric, at Pressing
1890—No. 1395. Cupertino	Oct. 17	29.10	------	1.15	------	------	------
1893—No. 2118. Cupertino	Nov. 1	25.70	------	.77	------	.352	.62
1894—No. 2296. Mission San José	Oct. 12	23.50	------	.75	------	.153	.75

COLOR READINGS.

ETRAIRE DE L'ADHUI.	At Pressing.	
1893—No. 2118. Cupertino	62.5	1VR
1894—No. 2296. Mission San José	59.7	2-3VR

RECORD OF TREATMENT.

No. 1395. *Etraire de l'Adhui*, from Cupertino. A sample for must analysis received October 21, 1890, in fair condition, but overripe. The must showed 29.1% of solid contents by spindle and 1.15% of acid.

No. 2118. *Etraire de l'Adhui*, from Cupertino. A sample for must analysis was received November 1, 1893, in good condition, and mature. The bunches were of medium size, irregularly cylindrical, with small wings, well filled below, loose above; the berries were small, slightly elongated, soft, and juicy. The must showed 25.7% of solid contents by spindle and 0.77% of acid.

TINTA VALDEPEÑAS.

In southern Spain, where the bulk of the vineyards are planted with white grapes, it is the custom for each proprietor to keep a few red grapes for the making of small quantities of red wine for home use. These red grapes, which are of different varieties in the different districts, are called, indiscriminately, "Tintas." Among these varieties the only one of renown, or which produces a wine which finds its way beyond the place of its production, is the Tinta Valdepeñas.

The red wines of Valdepeñas have been famous since the days of Pliny, and now have the distinction of being the best if not the only good dry red wines of southern Spain. These wines do not seem to be all produced by the same grape. According to Portes and Ruyssen, many of the vineyards are planted with Burgundy grapes. The variety which has been imported into California, and which is described below, is, however, probably a native of Valdepeñas.

Description.—Leaves of medium size, coarsely and somewhat acutely dentate, deeply lobed, the upper sinuses very deep and often closed, the lower less deep but well marked, the petiolar quite closed; upper surface dark green, glabrous except when quite young, the lower grayish green, with fine tomentum and well-marked ribs; tips of the shoots yellowish and pubescent; bunches of medium size, conico-cylindrical, slightly shouldered, and close; berries of good size, round, with thick and very astringent skin; peduncles herbaceous and slender, pedicels slender and about half the length of the berries, which are covered with an abundant bloom.

The description which modern authorities give of the red wines of Valdepeñas is identical with that given by Cervantes. They are, according to this author, heavy-bodied, with full vinosity and a slightly bitter taste.

In California this Tinta has made some excellent dry wines. The grapes attain a rather high degree of sugar and rather low acid, but ferment without much trouble. In the coast counties the wine is deeply colored, heavy-bodied, alcoholic, astringent, and of good quality, but not marked character. At Tulare this grape has given one of the best dry red wines of the district. It has sufficient and stable color, good vinosity, some bouquet, and clean taste. As in Spain, the wine is slightly but not unpleasantly bitter. It is evidently one of the red grapes most suited to the hotter parts of the State for the production of dry red wines. It is not a success for sweet wines, which are too rough and astringent.

ANALYSES OF MUSTS AND WINES.

TINTA VALDEPEÑAS.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At 6 to 8 Months	Body
1890—No. 1402.	J. T. Doyle, Cupertino	Oct. 19	19.80	-----	.61	-----	-----	-----	-----	-----	-----	-----
1892—No. 1634.	Tulare	Aug. 6	23.90	-----	.24	-----	-----	-----	-----	-----	-----	-----
1893—No. 1902.	Tulare	Sept. 29	24.55	23.61	.38	.49	9.56	11.91	.262	.46	.48	3.60
No. 1924.	Paso Robles	Oct. 12	25.20	23.60	.41	.37	9.49	11.82	.205	.41	.56	3.10
No. 2041.	J. T. Doyle, Cupertino	Oct. 30	26.90	-----	.54	-----	-----	-----	.320	-----	-----	-----
1894—No. 2156.	Tulare	Sept. 17	25.10	24.64	.38	-----	-----	-----	.222	.41	.35	2.95

COLOR READINGS.

TINTA VALDEPEÑAS.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1893—No. 1902.	Tulare	30.5	1VR	13.1	4VR	14.0	5VR	11.5	1R	11.5	2R	9.8	2R
No. 1924.	Paso Robles	37.4	VR	18.7	5VR	17.1	3VR	16.3	4VR	12.5	1R	11.0	1R
No. 2041.	Cupertino	129.0	1-2VR	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1894—No. 2156.	Tulare	38.4	1VR	19.4	4VR	18.0	5VR	12.0	3R	-----	-----	-----	-----

RECORD OF TREATMENT.

No. 1402. *Tinta Valdepeñas*, from Cupertino. A sample for must analysis was received October 21, 1890. The grapes were in fair condition, but some were shriveled. The must showed 19.8% of solid contents by spindle and 0.61% of acid.

No. 1634. *Tinta Valdepeñas*, from Tulare station. A sample for must analysis was received on September 6, 1892, in good condition. The must showed 23.9% of solid contents by spindle and 0.24% of acid.

No. 1902. *Tinta Valdepeñas*, from Tulare station. Received September 29, 1893, in good condition, but a little overripe. The bunches were of medium size, conico-cylindrical, slightly shouldered, and close; the berries were of good size, round, with thick and very astringent skin; the peduncles were green and rather slender, the pedicels slender and about half the length of the berries, which were covered with abundant bloom. The composition of the must was 24.55% of solid contents by spindle and 0.38% of acid. The temperature of the grapes at crushing was 66°, and the maximum of 88° was reached on the fifth day. On the sixth day the murk was dry, and was drawn off.

At one month the wine was nearly clear, of good flavor, body, and high astringency. Two weeks later it was quite clear, tasted sound, but still contained a little sugar. At this date it was racked and taken to the cellar. At four months it was bright and nearly dry, with little bouquet, but of good body, tannin, and alcohol, and moderate acid—generally an agreeable wine, but a little flat. At seven months it had been racked three times, and was in good order and retained its good quality. At eleven months it had developed some bouquet and had improved generally. A week later the lees were examined and a few filaments found; the wine, however, was unaffected in taste, was nearly mature, and, considering the smallness of the sample, had kept very well. At seventeen months the wine was mature, retained its good qualities, and was bottled. One year from bottling the wine was bright, without deposit, clean-tasting, but with a slight bitterness. It had a little bouquet, good flavor, and full alcoholic strength. It was one of the best of the Tulare wines.

No. 1924. *Tinta Valdepeñas*, from Paso Robles station. Received October 12, 1893, in good condition. The grapes were somewhat overripe and shriveled; the bunches and berries were very small. The must showed 25.2% of solid contents by spindle and 0.41% of acid. There were only 40 pounds of grapes, and the fermentation, which started at 70°, was cool. It lasted five days, when the murk was drawn off quite dry.

Three weeks after pressing, the wine was nearly clear, full bodied, well flavored, with good astringency and moderate acid. It was racked twice, and became quite clear, but the smallness of the sample prevented it from being kept any length of time.

No. 2041. *Tinta Valdepeñas*, from Cupertino. Received October 31, 1893, in good condition. The bunches were large, conical, loose, on somewhat slender peduncles; the berries were large, nearly round, fleshy, on slender pedicels, and overripe. The must showed 26.9% of solid contents by spindle and 0.54% of acid.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF JURA TYPE.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric.		Body
									At Pressing	At 6 to 8 Months.	
	Sirah.										
1242	Fresno	1890	25.10	24.11	.43	.37	12.36	.244	.30	.48	2.70
1472	Fresno	1891	25.20		.48		12.36	.240	.51	.43	3.35
1278	Cupertino	1890	24.15		.67						
1370	Cupertino	1890	24.15		.52						
2044	Cupertino	1893	28.60		.58			.502			
2052	Cupertino	1893	28.20		.58			.553	.79		
1296	Mission San José	1890	25.30		.84	.22	12.46	.259	.71	.45	3.45
1341	Mission San José	1890	25.40		.64	.19	13.00	.301	.44	.38	3.32
1564	Mission San José	1891	27.35		.65		15.20	.411	.71	.43	3.20
1708	Mission San José	1892	23.25	23.13	.78	.35	11.55	.335	.83	.70	2.95
1952	Mission San José	1893	24.60		.94			.345	.77		
2076	Mission San José	1893	28.80	25.65	.63	.30	13.36	.256	.65	.67	3.30
2254	Mission San José	1894	23.70		.64			.236			
2269	Mission San José	1894	23.70		.68			.245			
1438	Tulare	1891	25.65		.37						
1616	Tulare	1892	23.70	22.23	.43	.30					
1635	Tulare	1892	25.10		.41						
1814	Tulare	1893	22.40	21.80	.62	.50	10.36	.141	.47	.51	3.20
2139	Tulare	1894	21.50	20.83	.65		11.00	.159	.58	.44	2.85
2153	Tulare	1894	24.00		.53						
1488	Paso Robles	1891	23.70		.50						
1492	Paso Robles	1891	24.80		.53						
1647	Paso Robles	1892	23.95		.69						
1879	Paso Robles	1893	22.60	20.99	.53	.43		.237	.46		
1895	Paso Robles	1893	25.85	25.53	.51	.37	12.36	.211	.51	.50	3.30
1664	Amador station	1892	26.40		.42						
2286	Amador station	1894	23.50		.48						
	Average, Fresno		**25.15**	**24.11**	**.45**	**.37**	**12.36**	**.242**	**.40**	**.45**	**3.03**
	Average, Cupertino		**26.28**		**.59**			**.528**	**.79**		
	Average, Mission San Jose		**26.01**	**24.39**	**.72**	**.26**	**13.11**	**.298**	**.68**	**.52**	**3.24**
	Average, Tulare		**23.72**	**21.62**	**.50**	**.40**	**10.68**	**.150**	**.53**	**.48**	**3.02**
	Average, Paso Robles		**24.18**	**23.26**	**.55**	**.40**	**12.36**	**.224**	**.48**	**.50**	**3.30**
	Average, Amador station		**24.95**		**.45**						

SUMMARY OF ANALYSES OF MUSTS AND WINES OF JURA TYPE—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric.		Body
									At Pressing	At 6 to 8 Months	
	Mondeuse.										
1312	Cupertino	1890	20.40		.79	.21	9.73	.237		.45	2.70
2037	Cupertino	1893	23.10		.69			.432		.98	
1334	Mission San José	1890	21.70		.76	.21	11.00	.294	.58	.50	2.58
1563	Mission San José	1891	22.15		.68		11.09	.259	.77	.53	2.30
1582	Mission San José	1891	22.60	22.22	.53		11.45	.272	.68	.43	2.70
1764	Mission San José	1892	19.75	19.54	.72		9.73	.256	.84	.74	2.60
2062	Mission San José	1893	22.60	21.40	.65	.21	10.36	.301	.74	.62	2.60
2264	Mission San José	1894	20.50		.57			.203			
1595	Kenwood	1891	23.70	22.22	.48	.33	12.18	.375	.58	.50	3.35
1617	Tulare	1892	22.30	21.80		.35					
1888	Tulare	1893	20.20	19.08	.45	.31	9.73	.256	.53	.46	2.30
2206	Tulare	1894	23.60		.47						
1729	Paso Robles	1892	22.05		.47						
1922	Paso Robles	1893	22.60	21.38	.45	.30	10.25	.195	.53	.70	3.60
2216	Paso Robles	1894	22.30		.53						
2174	Amador station	1894	21.50		.56						
	Average, Cupertino		**21.75**		**.74**	**.21**	**9.73**	**.335**		**.72**	**2.70**
	Average, Mission San Jose		**21.55**	**21.05**	**.65**	**.21**	**10.73**	**.262**	**.72**	**.56**	**2.55**
	Average, Tulare		**22.03**	**20.44**	**.46**	**.33**	**9.73**	**.256**	**.53**	**.46**	**2.30**
	Average, Paso Robles		**22.32**	**21.38**	**.48**	**.30**	**10.25**	**.195**	**.53**	**.70**	**3.30**
	César.										
1594	Kenwood	1891	26.50	26.31	.50	.37	13.54	.544	.50	.40	3.35
	Etraire de L'Adhui.										
1395	Cupertino	1890	29.10		1.15						
2118	Cupertino	1893	25.70		.77			.352	.62		
2296	Mission San José	1894	23.50		.75			.153	.75		
	Average, Cupertino		**27.40**		**.96**			**.352**	**.62**		

	Tinta Valdepeñas.										
1402	Cupertino	1890	19.80	----	.61	----	----	----	----	----	----
2041	Cupertino	1893	26.90	----	.54	----	----	.320	----	----	----
1634	Tulare	1892	23.90	----	.24	----	----	----	----	----	----
1902	Tulare	1893	24.55	23.61	.38	.49	11.91	.262	.46	.48	3.60
2156	Tulare	1894	25.10	24.64	38	----	----	.222	.41	.35	2.95
1924	Paso Robles	1893	25.20	23.60	.41	.37	11.82	.205	.41	.56	3.10
	Average, Cupertino	----	**23.35**	----	**.58**	----	----	**.320**	----	----	----
	Average, Tulare	----	**24.52**	**16.08**	**.33**	**.49**	**11.91**	**.242**	**.44**	**.42**	**3.28**

SOUTHERN FRENCH TYPE.

(See Vit. Rept. 1887-89, p. 166.)

The conditions of the vast vine-growing district of Southern France are such as to make the production of large quantities of wine of medium quality more desirable than smaller quantities of high-class wines. We thus find that all the varieties of vines cultivated extensively there are heavy bearers and produce wines more suitable to blending purposes than for direct consumption. Of these varieties several have been planted extensively in California, and in many cases have given excellent results.

The *Carignane* and *Mataro*, which are the most extensively cultivated in France, have been given a large place in California vineyards. They give good results, however, only on warm, well-drained soils and in early localities. Contrary to the experience in France, the Carignane gives here, in almost every case, a wine of higher quality than the Mataro. On rich, low soils, though it bears well, it gives a poor wine, lacking in color and quality.

The *Grenache* and *Mourastel* cannot be recommended for any locality yet tried, though the former has been used to make some fair sweet, white wines. The *Ploussard* may be considered as a failure.

The *Cinsaut* is not well adapted to the cooler portions of the State, where its sugar content does not go sufficiently high; but it is a heavy and regular bearer, and in the hot valleys would probably develop the qualities for which it is noted in France. On account of its handsome aspect and pleasant flavor, it would be useful to a limited extent as a table grape for local markets.

The *Aramon* is worthy of further trial, and will doubtless be of use for the production of light, red wines in some localities. In the hot central valleys it makes a fair wine, easily fermented, but totally lacking in color, and generally too light and thin. In the cooler coast counties it generally fails to ripen properly; but in early seasons, when the crop is moderate, it makes a very agreeable light wine, with brilliant and sufficient color. In the warmer exposures of the earlier parts of the coast counties it will make a good light wine for early consumption, as it matures very quickly. It will doubtless be found useful for blending with heavier wines.

The *Petit Bouschet* has not been an unqualified success. As a coloring grape it is equaled or surpassed by grapes of higher quality in localities where the production of color is difficult; while in other localities its coloring properties are not needed, and its wine is not generally of high enough quality, to be worth growing for itself in the presence of superior kinds. The best results that have been obtained with it have been on heavy clay soils.

The *Bastardo* and *Trousseau*, which closely resemble each other, may be considered as of doubtful value under our conditions.

The *Beclan* is placed in this category on account of the character of its wine, which, though suitable for blends with fine wines, resembles the Southern French wines in its smoothness, low acidity, and neutrality. It is for this reason an excellent grape to plant in connection with the rougher Medoc or Jura grapes, to soften and diminish their too intense character.

ARAMON.

(See Vit. Rept. 1883-85, p. 105; 1887-89, p. 166.)

The later analyses of this variety show that the deficiency in acid noticed at first was in all probability due to the youth of the vines, as since then it has shown from medium to full acid at all localities. The average composition of the must has been: at Mission San José, sugar 22.35%, acid 0.62%; and at Cupertino, sugar 22.3%, acid 0.52%. At Tulare this vine is a strong grower and immense bearer, yielding eight to ten tons per acre with short-pruning. As much as 84 lbs. have been taken from one vine in the row. The grapes attain a fair amount of sugar and acid, considering the size of the crop, but when the crop is very large they are very deficient in tannin. The grapes have the pleasant astringent taste so characteristic of the Aramon, but the percentage of skin is so small that the wine is seldom astringent enough when made up pure. The wine is also almost totally lacking in color and low in body. As a blending wine it is useful, on account of the productiveness of the vine, and because of its agreeable and somewhat delicate flavor. Blended with one third Tinta Amarella and one sixth Petit Bouschet, it has given good results. The indications are that it is better suited to the production of white wines than of red. At the Amador station in the foothills the Aramon is a healthy, strong grower, and yields regularly about four tons per acre with short-pruning. It gives more sugar than at Tulare, and has sufficient color.

ANALYSES OF MUSTS AND WINES.

ARAMON.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
						By Weight	By Volume		At Pressing	At Six Months	
1890—No. 1246. Fresno	Aug. 24	21.10	20.99	.65	.36	8.48	10.58	.248	.50	.39	2.82
No. 1377. Mission San José	Oct. 18	22.10	------	.81	.29	9.20	11.45	.149	.71	.36	2.58
No. 1414. Cupertino	Oct. 28	23.00	------	.51	.22	9.78	12.18	.298	.62	.44	2.82
1891—No. 1436. Tulare	Aug. 24	20.20	------	.53	------	------	------	------	------	------	------
No. 1474. Fresno	Aug. 28	21.50	------	.57	------	8.34	10.42	.210	.66	.44	2.60
1892—No. 1639. Tulare	Sept. 12	21.50	20.44	.57	.34	8.84	11.00	.242	.53	.44	2.65
No. 1659. Amador station	Sept. 16	20.30	------	.76	------	------	------	------	------	------	------
No. 1755. Paso Robles	Oct. 12	21.50	------	.48	------	------	------	------	------	------	------
1893—No. 1826. Amador station	Sept. 7	18.60	------	.86	.23	------	------	.182	.86	------	------
No. 1918. Tulare	Oct. 9	21.50	19.21	.74	.44	7.92	9.90	.147	.68	.47	2.60
No. 2054. Cupertino	Nov. 1	23.40	------	.62	------	------	------	.345	.79	------	------
1894—No. 2178. Amador	Sept. 24	20.40	------	.67	------	------	------	------	------	------	------
No. 2290. Tulare	Oct. 11	22.85	21.80	.48	------	8.48	10.58	.052	.56	------	2.65
No. 2290*a*. Tulare	Oct. 11	22.85	21.80	.48	------	------	10.75	.285	.42	.58	2.60
No. 2299. Mission San José	Oct. 13	22.80	------	.61	------	------	------	.147	.72	------	------
No. 2316. Amador station	Oct. 15	23 40	------	.45	------	------	------	------	------	------	------

COLOR READINGS.

ARAMON.	At Pressing.	One Month.	Two Months.	Three Months.
1891—No. 1474. Fresno	3.33 5VR+Y	Too light to be	read on scale.	
1892—No. 1639. Tulare	Too light to be	read on scale.		
1893—No. 1826. Amador station	21.0 4VR	------	------	------
No. 1918. Tulare	6.1 VR+Y	------	------	------
No. 2054. Cupertino	34.8 1-2VR	------	------	------
1894—No. 2290*a*. Tulare*	36.0 1VR	27.2 1-2VR	18.6 5VR	16.3 4VR
No. 2299. Mission San José	38.0 1VR	------	------	------

Blend ½ Aramon, ⅓ Tinta Amarella, ⅙ Petit Bouschet.

RECORD OF TREATMENT.

No. 1246. *Aramon*, from Margherita Vineyard, Fresno. Received August 26, 1890, in good condition, and mature. The must showed 21.1% of solid contents by spindle. The temperature of the grapes at crushing was 67°, and the maximum reached was 82°, on the third day. The murk was dry on the fifth day, when it was drawn off.

In three weeks the wine was nearly clear, and was racked. At three months it was clear, almost without color, of neutral but rather pleasing flavor, no bouquet, full astringency, and medium acid. A few days later lactic ferments were found in the lees, and the wine was pasteurized. At eight months it was clear, thin, and characterless, but with agreeable astringency. At fifteen months it was bright, with little bouquet or flavor, perfectly neutral, but still agreeable, and nearly mature. At seventeen months it was bottled. At three years the bottled wine was tasted, and found bright and in good condition, of a dark straw color, agreeably astringent, but without quality.

No. 1377. *Aramon*, from Mission San José. Received October 20, 1890, in fair condition; a few grapes were moldy, the bunches large and well filled. The must showed 22.1% of solid contents by spindle. The temperature of the grapes at crushing was 68°, and the maximum reached was 96°, on the fourth day. The murk was dry on the fifth day, when it was drawn off.

In one month the wine was nearly clear, with pleasant flavor and aroma, medium acid and astringency; in general, of good quality. It remained sound and in good condition for four months, when the after-taste had become a little suspicious, so the wine was pasteurized. It improved slightly for about ten or twelve months, after which it commenced to deteriorate, and soon became flat and poor. It was bottled at eighteen months, but did not improve in glass.

No. 1414. *Aramon*, from J. T. Doyle, Cupertino. Received October 30, 1890, in good condition. The must showed 23.0% of solid contents by spindle. The temperature of the grapes at crushing was 68°, and the maximum reached was 93°, on the third day. The murk was nearly dry on the fourth day, when it was drawn off.

In one month the wine was not quite clear, had good flavor and aroma, low acid, and full astringency. At three months it was clear, with pleasing bouquet and full flavor, still rough, but of good quality and with sufficient alcohol and body. After this the wine did not improve, and soon commenced to deteriorate. The wine was racked three times during the first year, and remained bright. The wine was bottled, part at sixteen and part at twenty-two months. At three years the bottled wines were tasted and found bright, fairly agreeable, but lacking in character and showing some bad acid.

No. 1436. *Aramon*, from Tulare station. A sample for must analysis was received August 27, 1891, in good condition. The must showed 20.2% of solid contents by spindle.

No. 1474. *Aramon*, from Margherita Vineyard, Fresno. Received August 31, 1891, in good condition. The must showed 21.5% of solid contents by spindle. The temperature of the grapes at crushing was 70°, and the maximum reached was 80°, on the third day. The murk was still a little sweet on the seventh day, when it was drawn off.

The wine was a little slow in clearing, but was clear in six weeks from crushing, clean-tasting, and with some flavor and aroma. It was racked three times during the first year, and remained in good order. It was at its best at about six months, when it was a light, agreeable, somewhat acid wine, sound, but with little character. After this it deteriorated, owing partly to the smallness of the sample. At sixteen months it was bottled; it had lost nearly all its color and looked like a white wine. At three and a half years the bottled wine was bright, without deposit; had good flavor, a little bouquet, and sufficient tannin; an agreeable wine but for slight odor of volatile acid.

No. 1639. *Aramon*, from Tulare station. Received September 15, 1892, in good condition. The must showed 21.5% of solid contents by spindle. The temperature of the grapes at crushing was 66°, and the maximum reached was 97°, on the fourth day. The murk was not quite dry on the fourth day, when it was drawn off.

In one month from crushing the wine was nearly clear, dry, and was racked and taken to the cellar. At four months it was nearly bright, with little bouquet, flavor, or color, but with full astringency and clean taste, promising to be a good neutral wine. It was racked for the second time at eight months, and after this did not improve, but lost all its color and became flat. At fifteen months it was bright, but flat, and not nearly as good a wine as the Carignane or Petit Bouschet of the same locality. It was bottled at nineteen months.

No. 1659. *Aramon*, from Amador station. A sample for must analysis was received September 19, 1892, in poor condition. The must showed 20.3% of solid contents by spindle.

No. 1755. *Aramon*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 21.5% of solid contents by spindle.

No. 1826. *Aramon*, from Amador station. Received September 8, 1893, in good condition. The bunches were small; the berries were small and not mature. The must showed 18.6% of solid contents by spindle.

No. 1918. *Aramon*, from Tulare station. Received October 9, 1893, in good condition. The bunches were irregular, large, well filled, but not close; the berries were very large, round, with little color, firm, juicy, mature, but not very sweet. The must showed 21.5 of solid contents by spindle. The temperature of the grapes at crushing was 66°, and the maximum reached was 95°, on the third day.

In three weeks the wine was nearly clear, and had very little color. In three months it was clear, clean-tasting, had a little bouquet and flavor, medium astringency, and low acid; in general, was a fair wine, but with hardly any color. At four months it was racked for the second time; at six months it had not improved much, and lacked bouquet and freshness.

No. 2054. *Aramon*, from J. T. Doyle, Cupertino. A sample for must analysis and for color and tannin tests was received October 31, 1893, in good condition. The bunches were over medium size, conical, well filled; the berries were large, round, crisp, juicy, and well colored. The must showed 23.4% of solid contents by spindle.

CINSAUT.

(See Vit. Rept. 1883–85, p. 104; 1885–86, p. 84; 1887–89, p. 212.)

Further experiments with the Cinsaut have confirmed its unsuitableness for the production of any but very common wines in the Bay region, if used alone. It is possible, however, to improve it very much and to make a very fair wine by judicious addition of some other grape in the fermenting-vat. No. 1789, a blend of 80% Cinsaut with 20% Alicante Bouschet, was a good ordinary wine with medium acid, astringency, and body, and good color. It had little character, but was smooth and pleasing. At Tulare the vine is a strong grower and good bearer, resisting alkali well and giving from six to seven tons per acre. On account of the large size and compactness of the bunches the grapes are subject to injury by the black mold (*Aspergillus niger*), which in the lower part of the San Joaquin Valley is so destructive to Zinfandel and other thin-skinned grapes with close bunches. The must attains a fair amount of sugar and medium acid, and ferments well. The wine is almost without color, of pleasant flavor, very low in tannin, and a poor keeper. It could doubtless be much improved by an addition of Refosco or Petit Bouschet. It makes a better white than red wine, but in this case also it is much improved by cutting with another wine, for instance with Burger. So far, the vines have not borne well at Paso Robles, nor at the Amador station, and at the latter they have been subject to coulure.

ANALYSES OF MUSTS AND WINES.

CINSAUT.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—No. 1408. Mission San José	Oct. 26	22.35	------	.44	.21	9.92	12.36	.122	-----	.41	2.58
1891—No. 1434. Tulare	Aug. 24	25.20	24.22	.52	.64	9.86	12.00	.120	.42	.30	3.80
No. 1477. Paso Robles	Aug. 30	18.60	-----	.58	------	------	------	------	-----	------	-----
1892—No. 1614. Tulare	Aug. 26	22.05	22.24	.58	-----	8.77	10.90	.103	.43	.47	2.95
No. 1655. Paso Robles	Sept. 13	22.60	------	.57	------	------	------	------	------	------	-----
No. 1789. Mission San José	Oct. 19	22.10	-----	.53	------	9.56	11.91	.196	.60	.50	2.70
1893—No. 1825. Amador station	Sept. 7	21.05	------	.69	------	------	------	.284	.83	------	-----
No. 1842. Tulare	Sept. 11	21.95	20.24	.62	.37	8.84	11.00	.083	.52	.49	2.60
No. 2050. Cupertino	Nov. 1	19.10	------	.61	------	----	------	.467	.79	------	-----
1894—No. 2138. Tulare	Sept. 10	22.00	21.38	.47	------	8.48	10.58	.136	.42	.42	2.60
No. 2159. Amador station	Sept. 17	26.50	------	.45	------	------	------	------	------	------	-----
No. 2307. Mission San José	Oct. 13	20.85	------	.44	------	------	------	------	------	------	-----

COLOR READINGS.

CINSAUT.	At Pressing.	One Month.	Two Months.	Three Months.	Four Months.	Five Months.
1891—No. 1434. Tulare	7.8 5VR+Y	5.5 VR+2Y	3.3 3R+2Y	----------	----------	----------
1892—No. 1614. Tulare	5.5 2VR+Y	3.8 5VR+2Y	----------	----------	----------	----------
No. 1789.* Mission San José	62.5 1VR	57.1 1VR	52.0 2VR	34.5 3VR	31.0 3-4VR	29.2 3-4VR
1893—No. 1825. Amador station	45.6 1VR	----------	----------	----------	----------	----------
No. 1842. Tulare	4.2 1R	6.2 1VR+Y	----------	----------	----------	----------
No. 2050. Cupertino	30.8 1-2VR	----------	----------	----------	----------	----------
1894—No. 2138. Tulare	10.0 3R+Y	4.4 (Y)	4.2 (Y)	4.1 (Y)	----------	----------

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* Blend of Cinsaut and Alicante Bouschet.

RECORD OF TREATMENT.

No. 1408. *Cinsaut*, from Mission San José. Received October 29, 1890, in good condition, and mature. The must showed 22.35% of solid contents by spindle and 0.44% of acid. The temperature of the grapes at crushing was 68°. The fermentation was carried on in a closed vat, and without foulage. At the end of two weeks the vat was opened; the cap was hard and smelled perfectly sound; the space above was filled with gas, and the wine was quite dry.

In one month the wine was clear, of pleasing flavor and aroma, clean taste, low acid, and medium astringency; in general, the wine was very agreeable. Two weeks later it was racked in good order, and the lees seemed to be sound. At three months, however, the lees showed many filaments and the taste was affected. The wine was pasteurized, but remained flat and quite ceased to improve.

No. 1434. *Cinsaut*, from Tulare station. Received August 27, 1891, in good condition. The must showed 25.2% of solid contents by spindle and 0.52% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 92°, on the fourth day. On the sixth day the murk was dry, and was drawn off.

In three weeks the wine was nearly clear and quite dry. A month later it had become a little cloudy, and tasted bitter and suspicious of secondary fermentations; it was pasteurized, and at four months was clear; it had developed some bouquet, but tasted thin and insipid. After this it gradually deteriorated, and at nine months it had lost nearly all its character and was quite valueless.

No. 1477. *Cinsaut*, from Paso Robles station. A sample for must analysis arrived in good condition September 3, 1891. The grapes were not quite mature; the berries were rather small for the variety, but well colored and the bunches well filled. The must showed 18.6% of solid contents by spindle and 0.58% of acid.

No. 1614. *Cinsaut*, from Tulare station. Received August 29, 1892, in good condition, except for a few bunches covered with black mold, which were rejected; some bunches were not quite mature. The must showed 22.05% of solid contents by spindle and 0.58% of acid. The temperature of the grapes at crushing was 65°, and the maximum reached was 96°, on the fifth day. On the seventh day the murk, being nearly dry, was drawn off.

In one month the wine was clear, clean-tasting, and perfectly dry. At four months it had been racked twice, and was clear, but had an unpleasant odor; the lees were sound. At six months the wine was clear and had changed little, but the lees showed some filaments, and it was therefore pasteurized. After this it gradually deteriorated, becoming flat and insipid.

No. 1655. *Cinsaut*, from Paso Robles station. A sample for must analysis was received September 16, 1892. The must showed 22.6% of solid contents by spindle and 0.57% of acid.

No. 1789. *Cinsaut*, from Mission San José. Received October 21, 1892, in poor condition. The must showed 22.1% of solid contents by spindle and 0.53% of acid. The temperature of the must at crushing was 64°, and the maximum reached was 87°, on the third day. On the fourth day the murk was dry, and was drawn off. This sample was fermented with No. 1790 in the proportion of 80% of Cinsaut to 20% of Alicante Bouschet.

The wine was racked one month after pressing, and at three months was clear, clean-tasting, but still a little sweet. At five months it was in good condition, smooth, full-bodied, not quite dry, but sound both according to taste and to the microscopic examination of the lees. At seven months it was racked for the second time, and the lees were found still sound. At fourteen months the wine was bright, perfectly dry, smooth, and pleasing, with little bouquet or flavor, but agreeable acid and astringency. It was mature, and part of it was bottled; the rest was bottled at eighteen months.

No. 1825. *Cinsaut*, from Amador station. A sample for must analysis was received September 8, 1893, in good condition; the bunches were loose and coulured, the berries small. The must showed 21.05% of solid contents by spindle and 0.69% of acid.

No. 1842. *Cinsaut*, from Tulare station. Received September 12, 1893, in good condition. The bunches were large, well filled, and unevenly colored, the larger bunches having berries with hardly any color at all; the berries were very fine and large, and tasted mature. The must showed 21.95% of solid contents by spindle and 0.62% of acid. The grapes were pressed and the must fermented for white wine. The temperature of the must at starting was 66°, and the maximum reached was 87°, on the second day. The wine was dry on the fourth day, and on the tenth was racked.

In three weeks the wine was nearly clear, fresh, and clean-tasting. At four months it was a passable wine, without character, but with no defect except a slight bitterness. At five months it was racked for the third time; it was much improved, very smooth, and clean-tasting. At twelve months it had not changed much; it had developed a little bouquet, and was in good condition. The acid was rather low, and a blend with two-fifths Burger (No. 1908) made a great improvement.

No. 2050. *Cinsaut*, from Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were over medium in size, long-conical, well filled; the berries large, oval, juicy, mature, well colored. The must showed 19.1% of solid contents by spindle and 0.61% of acid.

GRENACHE.

(See Vit. Rept. 1883–85, p. 107; 1887–89, p. 206.)

The Grenache is characterized in most localities by vigorous growth and abundant foliage, and when not injured by mildew or coulure it is a heavy bearer. When pruned short in the ordinary way it is apt to shade its grapes too much; and, especially in moist seasons, if not well sulphured, is very subject to mildew. In Santa Clara, Alameda, and San Diego counties it is reported as being very subject to coulure. At Fresno it bears well and develops high sugar and medium acid; the average of five analyses is, sugar 25.9% and acid 0.45%.

At Tulare the vine is a strong grower and bears from six to ten tons per acre in the somewhat alkaline, sandy soil in which it is planted. The composition of the must has been good and fairly constant, varying little from the average of 23.5% of sugar and 0.50% of acid shown by four analyses. It ferments well, but makes a neutral wine almost totally lacking in color, with little quality, and much inferior to that of Refosco from the same vineyard. Its chief merits are vigor and heavy bearing, and in the latter, at least, it is surpassed by the Petit Bouschet, a much preferable grape.

At Paso Robles the composition of the must is practically the same as at Tulare as regards sugar and acid, but it makes a wine of somewhat better quality, though still lacking in color and quality.

At the Amador station the vine is a strong grower and good bearer, but somewhat inclined to coulure.

One of the disadvantages of the wine of this grape is the peculiar "burnt-sugar" flavor which it carries into all blends not strongly flavored otherwise, and which is not generally liked.

ANALYSES OF MUSTS AND WINES.

GRENACHE.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—No. 1249.	Fresno	Aug. 25	24.10	23.72	.57	.40	9.70	12.09	.153	.55	.46	3.02
No. 1333.	Cupertino	Oct. 11	24.35	------	.62	------	------	------	------	------	------	------
1891—No. 1444.	Tulare	Aug. 26	22.60	------	.53	------	------	------	------	------	------	------
No. 1527.	Paso Robles	Oct. 5	24.40	24.12	.45	------	9.70	12.09	.180	------	.40	2.55
1892—No. 1626.	Tulare	Sept. 3	23.25	23.13	.47	.35	9.41	11.73	.172	.55	.48	2.90
No. 1721.	Paso Robles	Oct. 10	22.60	22.23	.56	.45	9.05	11.27	.146	.50	.55	2.85
1893—No. 1822.	Amador station	Sept. 7	23.25	------	.74	------	------	------	.288	.80	------	------
No. 1845.	Tulare	Sept. 14	22.80	20.61	.53	.33	8.84	11.00	.109	.52	------	2.70
No. 2010.	Paso Robles	Oct. 26	28.20	27.65	.51	.29	11.08	13.54	.224	.51	.60	2.85
1894—No. 2170.	Tulare	Sept. 24	25.10	24.97	.47	------	10.44	12.91	.150	.40	.44	2.85
No. 2193.	Amador station	Sept. 25	28.00	------	.46	------	------	------	------	------	------	------

COLOR READINGS.

GRENACHE.		At Pressing.	One Month.	Two Months.	Three Months.	Four Months.	Five Months.	Six Months.
1891—No. 1527.	Paso Robles	18.0 R-1R	9.3 1R	4.0 2R+Y	------	------	------	------
1892—No. 1626.	Tulare	20 0 2R	10.5 1VR+Y	10.0 1VR+Y	9.3 3VR+Y	6.3 3R+Y	------	5.7 3R+Y
No. 1721.	Paso Robles	28.8 2VR	18.1 5VR	14.3 R	11.1 R	9.1 R	7.8 R	------
1893—No. 1822.	Amador station	22.0 5VR	------	------	------	------	------	------
No. 1845.	Tulare	3.8 2R+2Y	------	------	------	------	------	------
No. 2010.	Paso Robles	24.4 3VR	10.4 1R	9.6 1R	10.2 1R	10.0 R	------	------
1894—No. 2170.	Tulare	Color too light and too yellow to be read on the scale.						

RECORD OF TREATMENT.

No. 1249. *Grenache*, from Margherita Vineyard, Fresno. Received August 27, 1890, in good condition, and mature. The must showed 24.1% of solid contents by spindle. The temperature of the grapes at crushing was 69°, and the maximum reached was 78°, at which temperature it remained during the fourth and fifth days. The fermentation was slow in starting and tardy in finishing; the murk was drawn off on the seventh day while still sweet, and the fermentation continued in the cask; six days after pressing the wine was quite dry.

At ten weeks the wine was of fair quality and bright, the color was light, and the wine had little flavor or aroma, but was clean-tasting and with good acid and tannin. A month later the wine was racked for the second time, and soon after an examination of the lees showed the presence of a little lactic ferment, but the taste was unaffected, and the wine, having developed a little bouquet, had improved generally. It was pasteurized for safety. After this the wine did not improve much, but remained bright, and a coarse but drinkable wine. At eighteen months it was mature, and was bottled. At three years the bottled wine was tasted; that bottled at eighteen months was in good condition, but had lost nearly all its red color and was of deep straw color; it was without any positive defect, but lacked freshness and character. Some of the wine bottled earlier had retained some color, but had not kept well.

No. 1333. *Grenache*, from J. T. Doyle, Cupertino. Received October 13, 1890, in good condition, and mature. The must showed 24.35% of solid contents by spindle and 0.62% of acid.

No. 1444. *Grenache*, from Tulare station. A sample for must analysis was received August 29, 1891, in good condition. The must showed 22.6% of solid contents by spindle and 0.53% of acid.

No. 1527. *Grenache*, from Paso Robles station. Received October 7, 1891, in good condition. The must showed 24.4% of solid contents by spindle and 0.45% of acid. The grapes were fermented with No. 1528, Mourastel, from the same vineyard. The temperature of the grapes was 64° at crushing, and reached a maximum of 86° on the third day. On the fifth day the murk was nearly dry, and was drawn off.

At one month from pressing the wine was clear, had a little aroma and flavor, was smooth, but tasted a little flat. During the first three months the wine was racked twice; the lees were examined and found to be sound. At five months the wine was clear and sound, but flat, characterless, and of poor quality. It was racked three times during the next twelve months, and remained clear, but improved very little in quality. At fifteen months it was bottled. The wine improved considerably in bottle, and at three and a half years was a fair wine, but rather thin, and lacking in color and flavor.

No. 1626. *Grenache*, from Tulare station. Received September 6, 1892, in fair condition. The must showed 23.25% of solid contents by spindle and 0.47% of acid. The temperature of the must at crushing was 68°, and the maximum reached was 99°, on the fourth day. On the sixth day the murk was nearly dry, and was racked off.

At one month the wine was nearly clear, very promising, but still a little sweet. Two weeks later it was clear and nearly dry. At four months it was clear, but still slightly sweet, and not quite clean-tasting. An examination of the lees showed the presence of filaments, and the wine was pasteurized. Two months after pasteurizing it was racked, and was bright and nearly dry, but of poor quality. After this it gradually improved, and remained bright and sound. At nineteen months it was bottled.

No. 1721. *Grenache*, from Paso Robles station. Received October 13, 1892, in good condition; the grapes were small and tasteless. The must showed 22.6% of solid contents by spindle and 0.56% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 82°, on the third day. On the fourth day the murk was nearly dry, and was drawn off.

At one month the wine was racked, being nearly clear, dry, and promising. At three months it was bright, smooth, and pleasing, with moderate acid and astringency. Successive tastings at five, eight, and fourteen months showed a gradual improvement; it kept well, and was sound and pleasant, but lacked character. At eighteen months it was mature, and was bottled.

No. 1822. *Grenache*, from Amador station. Received September 8, 1893, in good condition. The bunches and berries were of fair size, lacking in color and not quite mature. Only a sample for must analysis was received. The must showed 23.25% of solid contents by spindle and 0.74% of acid.

No. 1845. *Grenache*, from Tulare station. Received September 14, 1893, in good condition, and mature. The bunches were of medium size, from well filled to compact, the skin very tough and thick, with very little color. The must showed 22.8% of solid contents by spindle and 0.53% of acid. The temperature of the must at crushing was 68°, and the maximum reached was 93°, on the third day. On the fifth day the murk was nearly dry, and was drawn off.

The wine fermented for some time and remained cloudy, but at the end of a month was nearly clear, and clean-tasting. At five months it was bright, a little sweet, with little bouquet or flavor, but clean-tasting, and was racked for the second time. After this it improved, remaining sound and agreeable. At eleven months it was in good order and had rather more character than the Carignane of the same year and locality (No. 1887), but no more color.

No. 2010. *Grenache*, from Paso Robles station. Received October 26, 1893, in good condition. The bunches were over medium in size, short, cylindrical, from well filled to compact, on very thick peduncles; the berries were of medium size, nearly round, firm, very sweet, and some dried. The must showed 28.2% of solid contents by spindle and 0.51% of acid. The temperature of the grapes at crushing was 62°, and the maximum of 77° was reached on the fifth day. On the fifth day the murk was nearly dry, and was drawn off.

In two weeks the wine was nearly clear, but still a little sweet. It was racked, taken to the cellar, and at two months was quite clear, of good, medium acid and astringency, some flavor, sub-sweet, but sound. At six months it was smooth and agreeable, without much character, but sound and in good order. At nine months it had improved in flavor, but had suffered from the smallness of the sample.

PLOUSSARD.

(See Vit. Rept. 1885–86, p. 82; 1887–89, p. 220.)

The Ploussard has unfortunately only been tested at the Bay region stations. It has proved but a moderate bearer, even with long-pruning, doing the better, in this respect, at Mission San José, of the two stations tried. It has shown some good qualities, but has by no means sustained its French reputation. It makes an alcoholic wine with low to medium acid, deficient astringency, and good body. The color is at first fair, but it quickly falls and turns yellow. The wine develops very quickly, and is at first very agreeable, but is a poor keeper and quickly deteriorates. It might be useful as a blend to give some of its delicacy to coarser varieties, but it ripens one or two weeks before any of the varieties with which it would make appropriate blends. It is an extremely delicious table-grape, and would be useful as an early red eating-grape for consumption near the vineyard, but it is too delicate to bear shipment.

ANALYSES OF MUSTS AND WINES.

PLOUSSARD.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
							By Weight	By Volume		At Pressing	At Six Months	
1890—No. 1261.	Mission San José	Sept. 24	24.80	------	.55	.34	9.78	12.18	.115	.46	.41	2.95
No. 1291.	Cupertino	Oct. 1	25.10	------	.57	.21	------	------	------	------	------	------
1891—No. 1505.	Mission San José	Sept. 24	25.30	25.41	.45	------	10.16	12.64	.188	.41	.42	3.05
1892—No. 1637.	Mission San José	Sept. 10	22.00	------	.57	------	------	------	------	------	------	------
1893—No. 1983.	Mission San José	Oct. 19	25.90	24.75	.56	------	10.81	13.27	.182	.58	.61	2.80

COLOR READINGS.

PLOUSSARD.	At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1891—No. 1505—Mission San José	13.65	2R	14.3	1VR+Y	13.9	4VR+Y	9.4	3R+Y	9.0	3R+Y	9.6	3R+YY
1893—No. 1983—Mission San José	29.80	5VR	13.7	2R	13.4	3R	11.8	3R	8.2	(Y)	--	----------

RECORD OF TREATMENT.

No. 1261. *Ploussard*, from Mission San José. Received September 27, 1890, in fair condition, and mature. The must showed 24.8% of solid contents by spindle and 0.55% of acid. The temperature of the must at crushing was 67°, and the maximum reached was 85°, on the fourth day. On the fifth day the murk was drawn off while still a little sweet.

The wine remained cloudy for some time, but at one month it was dry and nearly clear. At two months it was clear, very poor in color, of medium acid and astringency, showing a good flavor somewhat masked by the taste of moldy grapes. At three months it was considerably improved and developed, but as the taste was a little suspicious it was pasteurized. After this it remained bright and lost its moldy taste; it was in a small keg and developed very quickly. At seven months it had some bouquet and was very smooth and agreeable. After this it deteriorated and lost the little color it had to start with. At sixteen months it was bottled, but tasted somewhat thin and exhausted. It did not improve in bottle, but soon became decrepit.

No. 1291. *Ploussard*, from Cupertino. A sample for must analysis was received October 3, 1890, in bad condition, much bruised, and quite mature. The must showed 25.1% of solid contents by spindle and 0.57% of acid.

No. 1505. *Ploussard*, from Mission San José. Received September 27, 1891, in fair condition, a few grapes moldy. The must showed 25.3% of solid contents by spindle and 0.45% of acid. The temperature of the must at crushing was 67°, and the maximum reached was 92°, on the third day. The murk was drawn off on the fourth day, while still a little sweet.

At one month the wine was dry, nearly clear, but tasted flat. An examination of the lees showed the presence of a few filaments, and the wine was pasteurized. At six months it was bright, very light in color, with good body and alcohol, generally improved, and of fair quality. At sixteen months it had been racked three times and was in good order; and, being of fair quality and mature, it was bottled. At three years and a half the bottled wine was bright, with fair but yellowish color, of good flavor, but the bouquet injured by the presence of a little volatile acid.

No. 1637. *Ploussard*, from Mission San José. Received September 13, 1892, in fair condition. The must showed 22.0% of solid contents by spindle and 0.57% of acid. No wine was made.

No. 1983. *Ploussard*, from Mission San José. Received October 19, 1893, in good condition. The bunches were small to medium, loose, and winged; the berries were variable in size, ellipsoidal, and thin-skinned. The sample was very ripe, and many of the grapes dried. The must showed 25.9% of solid contents by spindle and 0.56% of acid. The temperature of the must at crushing was 62°, and the maximum reached, on the fifth day, was 92°. On the sixth day the wine was nearly dry, and was drawn off.

At one month the wine was nearly clear, and was racked and taken to the cellar. At three months it was clear, clean-tasting, with good flavor and some bouquet, good acid and astringency, but was still slightly sweet. During the spring the wine did not taste so well, but became quite dry, and at nine months had improved, was bright, and in good order; generally a good wine, but very poor in color. At this time an examination of the lees showed them to be perfectly sound.

TROUSSEAU.

(See Vit. Rept. 1885-86, p. 82; 1887-89, p. 201.)

Further experiments with the Trousseau show that it will make a fair Port in those localities where a Port is a possibility, but that for other purposes it is more or less a failure. For a dry red wine, without the aid of some other grape, it is quite useless, lacking sufficient color, acid, or tannin. An attempt to make it up into a white wine was little more successful. A sample of Trousseau from Asti, Sonoma County, with full sugar contents and medium acid, was made into white wine, which was rough, coarse, and totally lacking in the freshness which should characterize a white wine, but with better keeping qualities than this variety has when fermented on the skins. Wherever grown, if grown at all, it should be blended in the vat with some grape possessing sufficient acid to insure healthy fermentation.

ANALYSES OF MUSTS AND WINES.

TROUSSEAU.	Date of Picking	MUST.				WINE.						
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body	Sugar
						By Weight	By Volume		At Pressing	At Six Months		
1890—No. 1204. Fresno	Aug. 12	22.27	22.05	.58	.52	8.84	11.00	.084	.47	.43	2.60	------
1891—No. 1458. Fresno	Aug. 28	27.65	------	.61	------	*15.67	19.28	.160	.56	.20	*6.85	------
No. 1498. Asti, Sonoma County	Sept. 14	24.60	23.13	.41	.39	9.78	12.18	.065	------	.47	2.70	------
No. 1510. Mission San José	Sept. 25	25.20	26.31	.53	------	*14.64	18.03	.200	.40	.26	*3.03	2.07
1893—No. 1925. Paso Robles	Oct. 12	26.90	26.12	.26	.34	------	------	.176	.38	------	------	------
1894—No. 2335. Tulare	Oct. 19	26.80	------	.30	------	------	------	------	------	------	------	------

* Fortified.

COLOR READINGS.

TROUSSEAU.	At Pressing.		One Month.		Two Months.		Three Months.		Four Months.	
1891—No. 1458. Fresno	5.1	1VR+2Y	3.7	3VR+2Y	------	------	------	------	------	------
No. 1510. Mission San José	20.0	1R	9.3	2R+1Y	8.2	1VR+2Y	10.4	1VR+2Y	8.0	1R+2Y
1893—No. 1925. Paso Robles	10.9	1VR+1Y	------	------	------	------	------	------	------	------

RECORD OF TREATMENT.

No. 1204. *Trousseau*, from Margherita Vineyard, Fresno. Received August 14, 1890, in good condition, but for some moldy bunches. The bunches were of good size for the variety, and well filled; the skin with very little color, and the grapes generally not quite ripe, some of the bunches being quite green. The must showed 22.27% of solid contents by spindle and 0.58% of acid. The temperature of the must at crushing was 69°, and the maximum reached was 86°, on the fourth day. On the sixth day the murk was dry, and was drawn off.

The wine was almost without color and of poor quality, and at three months began to develop a suspicious taste. An examination of the lees showed long filaments, so the wine was pasteurized. After this it became bright, but did not otherwise improve.

No. 1458. *Trousseau*, from Fresno. Received August 31, 1891, in good condition, but slightly dried. The must showed 27.6% of solid contents by spindle and 0.61% of acid. The temperature of the grapes at crushing was 76°, and the maximum reached was 86°, on the third day. On the fourth day the murk was drawn off while still sweet; it fermented slowly in cask for ten days longer, when it was fortified. The wine did not keep well and acquired a bad taste.

No. 1498. *Trousseau*, from Asti, Sonoma County. Received September 17, 1891, in good condition, except for a few moldy bunches. The must showed 24.6% of solid contents by spindle and 0.41% of acid. The grapes were pressed and the must fermented for white wine. The temperature of the must at crushing was 69°, and the maximum reached was 78°, on the third day. It was dry on the seventh day, when it was racked from the lees.

At three weeks the wine was nearly clear and quite dry. At two months it was clear, with little aroma, smooth and pleasing, but without much character and with a slight schiller tint. A month later the lees showed a few filaments and the taste had become very slightly affected; the wine was therefore pasteurized. At six months it had developed some bouquet, but was flat and not of high promise. At nine months it had improved somewhat, and was smooth, oily, full-bodied, but with little character and none of the freshness of a good white wine. After this it was racked twice and was bottled at sixteen months, bright and sound, but coarse and of poor quality. At three and a half years the bottled wine was rough, coarse, and showed that it had been bottled too soon.

No. 1510. *Trousseau*, from Mission San José. Received September 27, 1891, in poor condition, many of the grapes moldy. The must showed 25.2% of solid contents by spindle and 0.53% of acid. The temperature of the grapes at crushing was 67°, and the maximum of 86° was reached on the second day. The murk was drawn off and fortified on the third day.

The wine soon cleared and was of good flavor, but rather too dry. It gradually improved, and at three and a half years was a light-colored, brownish Port, with full, agreeable bouquet and clean taste. On account of the smallness of the sample (three and a half gallons) it matured quickly, and by concentration, due to evaporation, became quite sweet enough. It was rather light in body, but otherwise a good Port.

No. 1925. *Trousseau*, from Paso Robles station. Received October 12, 1893, in good condition, but overripe and many berries dried. The bunches were of medium size, very compact and regular; the berries small, with little juice. The must showed 26.9% of solid contents by spindle and 0.26% of acid. Only a sample for must analysis was received.

BASTARDO.

(See Vit. Rept. 1883–85, p. 119; 1887–89, p. 256.)

There is little to be added to former reports on this variety; as a producer of dry red wine it may be said to be a failure. Its high sugar contents, together with its moderate or low acid, make it a difficult wine to ferment, and a poor keeper. The average composition of the must has been: at Cupertino, 25.6% of sugar, 0.46% of acid; at Mission San José, 25.8% of sugar, 0.55% of acid; at Tulare, 25.7% of sugar, 0.41% of acid. At Paso Robles the sugar content has been lower and the acid higher than these figures, but this is probably in part owing to the youth of the vines. The best use that can be made of this variety is in the manufacture of Ports with the aid of other grapes. At Tulare the vine is a fairly good grower where the alkali is not too strong, but a poor bearer and liable to sunburn.

ANALYSES OF MUSTS AND WINES.

BASTARDO.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—No. 1354. Cupertino	Oct. 12	25.77	-----	.44	-----	-----	-----	-----	-----	-----	-----
1891—No. 1479. Paso Robles	Sept. 1	22.90	-----	.43	-----	-----	-----	-----	-----	-----	-----
1892—No. 1625. Tulare	Aug. 28	24.80	-----	.41	-----	-----	-----	-----	-----	-----	-----
No. 1641. Paso Robles	Sept. 13	22.15	-----	.64	-----	-----	-----	-----	-----	-----	-----
No. 1709. Mission San José	Oct. 3	23.70	22.95	.85	.26	9.78	12.18	.262	.53	.39	3.15
1893—No. 1834. Amador station	Sept. 7	24.80	-----	.72	-----	-----	-----	.358	.68	-----	-----
No. 1865. Paso Robles	Sept. 15	23.90	22.95	.49	.34	9.30	11.48	.151	.38	.40	2.80
No. 2047. Cupertino	Nov. 1	28.00	-----	.63	-----	-----	-----	.252	.75	-----	-----
1894—No. 2149. Tulare	Sept. 17	26.50	-----	.41	-----	-----	-----	-----	-----	-----	-----
No. 2266. Mission San José	Oct. 5	25.90	-----	.47	-----	-----	-----	-----	-----	-----	-----

COLOR READINGS.

BASTARDO.	At Pressing.	One Month.	Two Months.	Three Months.	Four Months.	Five Months.
1892—No. 1709. Mission San José	81.7 VR	40.0 4VR	37.0 5VR	26.8 R	23.8 R	20.8 R
1893—No. 1834. Amador station	14.9 2R	12.4 3R	-----	-----	-----	-----
No. 1865. Paso Robles	10.0 2VR+Y	6.7 VR+Y	5.0 VR+Y	-----	-----	-----
No. 2047. Cupertino	18.2 4VR	-----	-----	-----	-----	-----

RECORD OF TREATMENT.

No. 1354. *Bastardo*, from Cupertino. Received October 13, 1890. The must showed 25.77% of solid contents by spindle and 0.44% of acid.

No. 1479. *Bastardo*, from Paso Robles station. A sample for must analysis was received September 3, 1891, in good condition; small, well-filled bunches of small grapes, mature. The must showed 22.9% of solid contents by spindle and 0.43% of acid.

No. 1625. *Bastardo*, from Tulare station. A sample for must analysis was received September 1, 1892, in good condition. The must showed 24.8% of solid contents by spindle and 0.41% of acid.

No. 1641. *Bastardo*, from Paso Robles station. A sample for must analysis was received September 16, 1892, in good condition. The must showed 22.15% of solid contents by spindle and 0.64% of acid.

No. 1709. *Bastardo*, from Mission San José. Arrived October 5, 1892, in fair condition. The must showed 23.7% of solid contents by spindle and 0.85% of acid. The grapes were fermented with No. 1700, Teinturier mâle, from the same vineyard. The temperature of the grapes at crushing was 68°, and the maximum of 97° was reached on the fourth day. On the fifth day the murk was nearly dry, and was pressed.

Three weeks after pressing the wine was clear and dry, but not of high promise. At one month it was racked and taken to the cellar. At two months it was bright, with full, good bouquet and flavor, but not clean-tasting; at this time the wine was of good quality, but was evidently not going to keep well. At four months it had acquired a slight bitterness, but was otherwise little changed. After this, though the wine remained bright and no injurious germs could be found in the lees, it became gradually flat and insipid, till at about fourteen months it was no longer worth keeping.

No. 1834. *Bastardo*, from Amador station. A sample for must analysis was received September 8, 1893, in good condition; the bunches were small and the berries slightly shriveled. The must showed 24.8% of solid contents by spindle and 0.72% of acid.

No. 1865. *Bastardo*, from Paso Robles station. Received September 15, 1893, in good condition; bunches small, compact, without coulure, and evenly ripened. The must showed 23.9% of solid contents by spindle and 0.49% of acid. The temperature of the grapes at crushing was 67°, and the maximum of 85° was reached on the third day. The wine was dry on the fifth day, when it was pressed.

The wine remained cloudy for some time, and continued an almost insensible fermentation. It was racked at one month and again at four months, but, though it became clear, it was flat and insipid. After this it changed little, and at one year it was drinkable, but not a good wine. The lees showed a few filaments.

No. 2047. *Bastardo*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were of medium size, long conico-cylindrical, close; the berries of medium size, oval, firm, fleshy, very sweet, and just commencing to dry up. The must showed 28.0% of solid contents by spindle and 0.63% of acid.

CHAUCHÉ NOIR.

(See Vit. Rept. 1885–86, p. 79; 1887–89, p. 112.)

This variety resembles the Pinots in its yellowish color and its liability to attacks by secondary fermentations, without having the delicacy of flavor which characterizes the latter. Though unsuited to be used alone, a fair wine can be made of it if the grapes are fermented with, say one third of some robust and tannic wine, such as the Tannat or some of the Italian varieties. It ripens much earlier than the latter, and would have to be blended during the after-fermentation. It cannot, however, be recommended for planting in any locality in California where it has yet been tried.

ANALYSES OF MUSTS AND WINES.

CHAUCHÉ NOIR.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—No. 1227. Fresno	Aug. 23	28.40	28.62	.34	.59	------	------	------	------	------	------
No. 1290. Cupertino	Oct. 1	25.00	------	.55	------	------	------	------	------	------	------
No. 1298. Mission San José	Oct. 5	26.30	------	.53	.39	10.81	13.27	------	------	.32	2.45
1891—No. 1446. Tulare	Aug. 26	26.90	------	.46	------	------	------	------	------	------	------
No. 1557. Paso Robles	Oct. 6	22.15	------	.82	------	------	------	------	------	------	------
1892—No. 1652. Paso Robles	Sept. 13	19.25	------	1.71	------	------	------	------	------	------	------
No. 1685.* Mission San José	Sept. 24	24.10	------	.64	------	9.70	12.09	.189	.53	.48	3.10
1893—No. 1795. Tulare	Aug. 31	22.80	21.38	.68	.60	8.48	10.58	------	.56	------	3.80
No. 1832. Amador station	Sept. 7	25.00	------	.68	------	------	------	.362	.67	------	------
No. 1868. Paso Robles	Sept. 15	21.95	20.99	.92	------	8.34	10.42	.112	.45	.56	3.10
No. 2075. Mission San José	Nov. 3	29.10	------	.47	------	11.62	14.20	.173	.54	.40	3.10
No. 2109. Cupertino	Nov. 1	30.90	------	.65	------	------	------	.307	------	------	------
1894—No. 2150. Tulare	Sept. 17	28.40	------	.45	------	------	------	------	------	------	------

COLOR READINGS.

CHAUCHÉ NOIR.	At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1891—No. 1685.* Mission San José	50.0	1VR	33.3	4VR	16.6	R	17.4	R	14.8	R	14.8	R-1R
1893—No. 1832. Amador station	18.9	3R	10.9	(Y)	------	------	------	------	------	------	------	------
No. 1868. Paso Robles	17.2	4VR	7.3	1R	5.9	2R	5.6	1R	5.8	3R	4.6	3R
No. 2075. Mission San José	26.8	4VR	17.0	R	15.4	R	13.1	R-1R	4.0	(Y)	------	------
No. 2109. Cupertino	22.7	4VR	------	------	------	------	------	------	------	------	------	------

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* Blend of Chauché noir 73% and Tannat 27%.

Record of Treatment.

No. 1227. *Chauché noir*, from Fresno. A sample for must analysis was received August 25, 1890, in fair condition—over-mature and some berries dried. The must showed 28.4% of solid contents by spindle and 0.34% of acid.

No. 1290. *Chauché noir*, from Cupertino. A sample for must analysis was received October 3, 1890, in fair condition, quite ripe. The must showed 25.0% of solid contents by spindle and 0.55% of acid.

No. 1298. *Chauché noir*, from Mission San José. Received October 7, 1890, in bad condition—much crushed and moldy. The must showed 26.3% of solid contents by spindle and 0.53% of acid. The grapes were crushed and fermented as white wine. The temperature at crushing was 67°, and the maximum reached, on the third day, was 83°.

The wine was dry on the tenth day and was racked from the lees. At one month the wine was clear, of light schiller color, smooth, with low acid and high alcohol, but the quality quite spoiled by the taste of mold. At six weeks the lees were not well settled, but seemed sound. At two months the wine was racked for the second time, and at three months the lees were examined again and found to contain some filaments, so the wine was pasteurized. It was clear and had improved somewhat. At seven months it was bright, but still showed the effects of the moldy grapes, and had acquired a Sherry taste. It was racked for the fourth time, and at fourteen months was clear and sound, but showed little improvement in taste. At seventeen months it was bottled, but did not keep well.

No. 1446. *Chauché noir*, from Tulare station. A sample for must analysis was received August 29, 1891, in good condition. The must showed 26.9% of solid contents by spindle and 0.46% of acid.

No. 1557. *Chauché noir*, from Paso Robles station. A sample for must analysis was received October 8, 1891, in good condition. The bunches were medium sized, well filled; the berries small and mature. The must showed 22.15% of solid contents by spindle and 0.82% of acid.

No. 1652. *Chauché noir*, from Paso Robles station. A sample for must analysis was received September 16, 1892, in good condition. The must showed 19.25% of solid contents by spindle and 1.71% of acid.

No. 1685. *Chauché noir*, from Mission San José. Received September 27, 1892, in good condition. The must showed 24.1% of solid contents by spindle and 0.64% of acid. The grapes were fermented with No. 1686 in the proportion of 149 lbs. of Chauché noir to 54.5 lbs. of Tannat. The temperature of the grapes at crushing was 67°, and the maximum reached on the fourth day was 96°. In four days and a half the wine was dry, and was drawn off.

In one month the wine was nearly clear, and was racked off and taken to the cellar. At three months it was bright, with some flavor and aroma, medium acid and astringency—a drinkable wine, but not of high quality, and slightly bitter. The lees were sound, and two months later the wine was in good condition and still possessed of a faint sweetness. It was racked for the second time, and a month later the lees showed much *S. ellipsoideus* and a few short filaments. The wine remained, however, in good order, and improved. Tastings at eight, ten, and fourteen months showed a gradual improvement, and at the end of that time it was of good quality and very smooth. It was bottled at eighteen months.

No. 1795. *Chauché noir*, from Tulare station. Received August 31, 1893, in bad condition. The bunches were of the usual size, but the berries were larger; they were flavorless and with little color. The must showed 22.8% of solid contents by spindle and 0.68% of acid. There were 205 lbs. crushed. The temperature of the must at crushing was 63°, and the maximum reached, on the fifth day, was 85°.

The wine was taken off the lees at two weeks, and at one month was nearly clear, and was racked again and taken to the cellar. At five months it was clear, but flat and of poor quality, and was racked for the third time. After this the wine deteriorated, and at one year was quite spoiled.

No. 1832. *Chauché noir*, from Amador station. A sample for must analysis was received September 8, 1893, in good condition. Both bunches and berries were very small, and the berries rounder than usual. The must showed 25.0% of solid contents by spindle and 0.68% of acid.

No. 1868. *Chauché noir*, from Paso Robles station. Received September 15, 1893, in good condition. The bunches were of good size, compact; the berries of average size, mature. The must showed 21.9% of solid contents by spindle and 0.92% of acid. There were 88 lbs. crushed at a temperature of 67°. The maximum temperature reached was 86°, on the fourth day. On the fifth day the wine was dry, and was drawn off.

At three weeks the wine was nearly clear, but of poor quality. It was racked and taken to the cellar, and at four months was clear, much improved, but lacking in color and character. At five months it was racked again, and at eight months it had changed little, was sound, but somewhat green. At eleven months the wine was in good order, sound, of fair quality; had deposited no lees, but did not taste mature. At twelve months it was bottled.

No. 2075. *Chauché noir*, from Mission San José. Received November 3, 1893, in good condition. The bunches were small, conico-cylindrical, with a small wing, close; the berries small, oval, firm, and crisp, very sweet, and overripe. The must showed 29.1% of solid contents by spindle and 0.47% of acid. The 95 lbs. crushed were fermented as red wine, started at a temperature of 63°, and reached a maximum of 88° on the third day. On the fifth day the wine was nearly dry, and was drawn off.

At one month, when it was racked and taken to the cellar, the wine was clear, but still a little sweet. At three months it was not quite clear, faintly sweet, with bitter after-taste, but of good flavor. After this it became still more bitter and generally deteriorated.

No. 2109. *Chauché noir*, from Cupertino. A sample for must analysis was received November 3, 1893, in good condition. The bunches were small, conico-cylindrical, well filled; the berries small, oval, pulpy, very ripe, but with good acid. The must showed 30.9% of solid contents by spindle and 0.65% of acid.

DOLCETTO.

Synonyms: Uva d'Aqui; Dolutz nero.

Description.—Vine rather vigorous and very productive, with short-jointed canes and prominent buds; young leaves of an intense vinous red, covered with a light, whitish down; tendrils, petioles, and nerves of leaves reddish; leaves rather large, and wider than long; bunch large, pyramidal, regular, winged, and well filled; berries bluish-black, round, and thin-skinned.

This variety is cultivated in the north of Italy, principally near Alba and Acqui, and especially on the higher slopes of the Alps and the high valleys of the Apennines. It is valued on account of its early ripening and heavy bearing. It makes a light, very smooth wine, which can be consumed early, on account of its quick development. It lacks the asperity which is so characteristic of most of the red wines of northern Italy when they are young, but it never attains the high quality of the Nebbiolo or Bonarda. The Dolcetto is prized also on account of its good color. In this respect, however, it has not retained its reputation in California. It will be a useful grape to plant for smooth, light, quickly maturing wines, where fair quality and large quantity are desired. It is an excellent table-grape, on account of its fine appearance, agreeable flavor, and early ripening, but is not tough enough for long shipments.

Analyses of Musts and Wines.

DOLCETTO.	Date of Picking...	MUST.				WINE.					Body..........
		Solid Contents by Spindle..	Sugar by Copper Test....	Acid as Tartaric.......	Ash......	Alcohol.		Tannin	Total Acid as Tartaric.		
						By Volume....	By Weight		At Pressing...	At 6 to 8 Months	
1890—No. 1348. Cupertino..	Oct. 13	19.50	------	.80	----	------	------	------	----	----	----
1891—No. 1572. Asti, Sonoma Co....	Oct. 8	*27.45	27.65	.31	.30	10.91	13.36	.210	.62	.44	2.60
1893—No. 2111. Cupertino..	Nov. 5	26.90	------	.58	----	------	------	.259	----	----	----

* Water and tartaric acid were added to the must.

Record of Treatment.

No. 1348. *Dolcetto* (Menlo No. 1), from J. T. Doyle, Cupertino. Received October 13, 1890, in fair condition, some of the bunches being moldy. The bunches were of medium size, conico-cylindrical, sometimes winged, not compacted; the berries over average in size, round, reddish-brown in color, with thin skin and soft, rather juicy flesh; peduncle short and green. The grapes resemble the true Dolcetto very closely, except in their lack of color. The must showed 19.5% of solid contents by spindle and 0.80% of acid. No wine was made.

No. 1572. *Dolcetto*, from Asti, Sonoma County. Received October 10, 1891, in fair condition, over-mature, very sweet, and many grapes half dried. The must showed 27.45% of solid contents by spindle and 0.31% of acid. The grapes (119 lbs.) were crushed at a temperature of 61°. On the second day 1.2 gallons of water and 83.5 grams of tartaric acid were added. The maximum temperature of 87° was reached on the fourth day. On the seventh day, when the wine was drawn off, it was nearly dry.

At one month the wine was bright, had light, delicate aroma, full flavor, clean taste, good astringency, and medium acid. It was racked, and at four months the lees showed a little "graisse," but the wine was bright, little changed, and tasted quite sound. A month later it was racked again. It was very smooth and pleasing, full-bodied, and clean-tasting; it was of excellent quality and was maturing quickly. At ten months it was racked again. At sixteen months it retained its good quality, but had not developed much bouquet. At this date it was racked and part put in bottle At twenty-two months, when the rest of the wine was bottled, it had improved and kept perfectly. At three years and three months the bottled wine was bright, of light color, somewhat deficient in bouquet, but very agreeable and smooth—an excellent wine of Burgundy type.

No. 2111. *Dolcetto*, from J. T. Doyle, Cupertino. A sample for must analysis was received November 7, 1893, in good condition. The bunches were large, irregular, conical, compact, shouldered; the berries large, round, pulpy, very sweet, and with a delicate sub-Muscat flavor. It differed from Mas and Pulliat's description of this variety in the compactness of the bunches, the pulpy nature of the berries, and the marked flavor. The must showed 26.9% of solid contents by spindle and 0.58% of acid.

CARIGNANE.

(See Vit. Rept. 1883–85, p. 92; 1885–87, p. 74; 1887–89, p. 171.)

The results obtained with this grape in different localities of California are somewhat discordant. In a few specially suitable localities it has produced a good wine, while in most others the wine is only from fair to poor. The best results have been obtained on well-drained soils in parts of the Santa Clara Valley and the upper Russian River Valley. In moist, rich soils the vines are very much subject to mildew, and require frequent sulphuring. The must generally possesses sufficient sugar and from medium to high acid. The wine is full-bodied, with medium to low astringency. In favorable localities it has sufficient color, but of a somewhat yellowish cast.

At Tulare and Fresno the Carignane is a thrifty, upright grower, a heavy bearer, and does well in fairly strong alkali. The must is rather low in sugar, with fair acid. It makes a good, neutral wine, lacking in color and tannin, but superior to that of Grenache or Cinsaut from the same place.

ANALYSES OF MUSTS AND WINES.

CARIGNANE.	Date of Picking	MUST.				WINE.						
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body	Sugar
1890—No. 1251. Fresno	Aug. 25	20.60	19.89	.74	.41	8.91	11.09	.125	.56	.48	2.36	------
No. 1335. Cupertino	Oct. 11	21.50	------	.72	------	------	------	------	------	------	------	------
No. 1409. Mission San José	Oct. 19	24.80	------	.95	.33	10.16	12.64	.213	.65	.66	3.08	.32
(*a*) Closed vat	------	24.80	------	.95	.27	10.63	13.09	.199	------	.54	2.82	.26
(*b*) With calcium sulphate	------	24.80	------	.95	.45	10.44	12.91	.213	------	.62	3.94	.28
(*c*) With calcium phosphate	------	24.80	------	.95	.40	9.78	12.18	.180	------	.56	3.22	.26
(*d*) With ammonium phosphate	------	24.80	------	.95	.39	9.92	12.36	.217	------	.48	3.82	.22
1891—No. 1447. Tulare	Aug. 26	21.70	------	.44	------	------	------	------	------	------	------	------
No. 1525. Asti, Sonoma County	Oct. 6	24.40	23.61	.48	.33	10.00	12.54	.240	.57	.48	2.78	------
No. 1576. Paso Robles	Oct. 10	19.70	17.44	.67	.35	7.23	9.00	.123	.63	.48	2.60	------
1892—No. 1628. Tulare	Sept. 3	21.50	18.89	.59	.38	8.34	10.42	.143	.54	.56	3.30	------
No. 1742. Paso Robles	Oct. 11	24.80	------	.35	------	------	------	------	------	------	------	------
No. 1791. Mission San José	Oct. 21	20.60	------	.99	------	8.27	10.36	.209	------	.78	3.00	------
1893—No. 1871. Amador station	Sept. 12	23.30	20.61	.90	.22	------	------	.400	------	------	------	------
No. 1887. Tulare	Sept. 22	20.60	18.90	.71	.26	7.92	9.90	.070	.56	.53	2.60	------
No. 2081. Paso Robles	Nov. 4	25.90	24.12	.51	.34	9.78	12.18	.154	.47	.48	3.30	------
1894—No. 2173. Amador station	Sept. 24	22.60	------	.68	------	------	------	------	------	------	------	------
No. 2210. Tulare	Sept. 27	22.20	21.22	.47	------	8.34	10.42	.146	.53	.44	2.60	------
No. 2223. Amador station	Oct. 3	25.40	------	.53	------	------	------	------	------	------	------	------
No. 2295. Mission San José	Oct. 12	20.20	------	.88	------	------	------	------	------	------	------	------

COLOR READINGS.

CARIGNANE		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.	
1891—No. 1525.	Asti, Sonoma County	44.0	2VR	28.6	3VR	21.7	4VR	15.4	1R	14.2	1R
No. 1576.	Paso Robles	33.3	3VR	14.4	4VR	7.6	R-1R	6.3	1R		
1892—No. 1628.	Tulare	13.3	4-5VR	7.4	3VR+Y	7.0	4VR+Y	6.0	R+Y	5.3	1R+Y
No. 1791.*	Mission San José	97.5	1VR	43.0	1VR	38.8	2VR	29.2	3VR	28.2	3VR
1893—No. 1871.	Amador station	71.4	4VR	55.5	1VR						
No. 1887.	Tulare	11.1	3VR	6.2	VR+Y	3.3	(YY)				
No. 2081.	Paso Robles	32.0	1VR	25.0	2VR	23.6	5VR	22.7	5VR		
1894—No. 2210.	Tulare	12.9	R	5.3	3R	6.2	2R	6.2	3R		

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* Blend of Carignane and Robin noir.

Record of Treatment.

No. 1251. *Carignane*, from Margherita Vineyard, Fresno. Received August 25, 1890, in good condition; bunches and berries very large, taste insipid, and watery. The must showed 20.6% of solid contents by spindle. The temperature of the grapes at crushing was 70°, and the maximum reached was 78°. The fermentation was very slow, and the must remained at about 78° for three or four days. On the seventh day the murk was drawn off when still sweet.

Six days after pressing the wine was dry, and in three weeks more clear. At two months it was bright, sound, very rough, and with little flavor. It was racked twice during the first seven months, and remained bright, becoming smoother, and at the end of that time was pleasant, but somewhat insipid. At seventeen months it was in good condition, with little color, some bouquet, neutral flavor, and full acid. Two months later it was mature, and some of it was bottled. At twenty-seven months the remainder was bottled. At three years both bottlings were sound, but flat and of poor quality.

No. 1335. *Carignane*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 13, 1890, in good condition, and mature. The must showed 21.5% of solid contents by spindle.

No. 1409. *Carignane*, from Mission San José. Received October 20, 1890, in fair condition, very soft and a few bunches moldy. The must showed 24.8% of solid contents by spindle. The grapes were used for a series of experimental fermentations, for the results of which see "Fermentations with various substances" (Part II of this report).

No. 1447. *Carignane*, from Tulare station. A sample for must analysis was received August 29, 1891, in good condition. The must showed 21.7% of solid contents by spindle.

No. 1525. *Carignane*, from Asti, Sonoma County. Received October 8, 1891, in good condition, and mature. The must showed 24.4% of solid contents by spindle. The temperature of the must at crushing was 66°, and the maximum of 81° was reached on the sixth day. On the ninth day the murk was drawn off while still a little sweet.

One month from pressing the wine was bright, quite dry, very rough, and with a burnt taste. At five months the wine had been racked twice, and was bright, vinous, with good body and some bouquet, generally much improved. It continued to improve and at sixteen months had developed into an excellent wine. Some of the wine was bottled at sixteen months, and some at twenty-two months. At three and a half years the wine last bottled was bright, with good color, marked bouquet, and full flavor, generally an excellent, clean-tasting wine, a little too astringent, but full and round. There was a little well-settled deposit in the bottles. The wine first bottled tasted undeveloped and had made a heavy deposit.

No. 1576. *Carignane*, from Paso Robles station. Received October 12, 1891, in good condition, but not mature; the grapes were very small. The must showed 19.7% of solid contents by spindle. The temperature of the grapes at crushing was 64°, and the maximum reached was 82°, on the third day. The murk was nearly dry on the third day, and was drawn off on the fourth.

At one month from pressing the wine was nearly clear, but coarse and not pleasing. At six months it had been racked twice, and was bright, had developed some bouquet, and was much improved, though still rough. It was racked twice after this, and remained bright, but did not improve much. At fifteen months it was bottled. The wine developed too quickly, owing to smallness of sample, and, though it kept in good order in bottle, did not develop its best qualities.

No. 1628. *Carignane*, from Tulare station. Received September 6, 1892, in good condition, and mature. The must showed 21.5% of solid contents by spindle. The temperature of the grapes at crushing was 69°, and the maximum reached was 87°, on the fourth day. The murk was dry on the fifth day, when it was drawn off.

A month after pressing the wine was clear, and was racked and taken to the cellar. At four months it was bright, fresh, smooth, and pleasing, but with little flavor. It was racked three times during the first year, and remained in good condition; was a good, clean-tasting, neutral wine, with little character. At fifteen months it was nearly mature, and was one of the best of the Tulare wines; the color was very deficient. At twenty-two months it was bottled. One year after bottling it was bright, with some bouquet and flavor, full acid for a Tulare wine—a good wine, but lacking in character, solidity, and color, yet superior to many of the Tulare wines.

No. 1742. *Carignane*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 24.8% of solid contents by spindle.

No. 1791. *Carignane*, from Mission San José. Received October 21, 1892, in poor condition. The must showed 20.6% of solid contents by spindle. This variety was fermented with No. 1792, Robin noir, from the same locality, about equal parts of each being used. The temperature of the grapes at crushing was 63°, and the maximum reached was 88°, on the third day. The murk was drawn off on the fourth day, when nearly mature.

A month after pressing the wine was nearly clear. At three months it was bright, rough and coarse, but sound and of good body. It was racked three times during the first year, remained in good order, and gradually improved, losing its harshness. At fourteen months it was nearly mature, and at eighteen months was bottled.

No. 1871. *Carignane*, from Amador station. A sample for must analysis and for acid and tannin tests was received September 14, 1893, in good condition. The bunches were large, the berries small and well colored. The must showed 23.3% of solid contents by spindle.

No. 1887. *Carignane*, from Tulare station. Received September 22, 1893, in good condition. The bunches were large and compact; the berries large and mature, but not well colored or very sweet. The ripening was irregular, some of the bunches had dried berries, and some had berries still uncolored. This was due to the fact that some of the vines had grown in strong alkali ground, where they produced scantier foliage, and thus allowed the grapes to ripen earlier. The must showed 20.6% of solid contents by spindle. The temperature of the grapes at crushing was 65°, and the maximum reached was 92°, on the third day. On the fourth day the murk was dry, and was drawn off.

In three weeks the wine was clear. At five months the wine had been racked twice, was bright and pleasing. At eight months it was sound, but flat and without much character or color.

No. 2081. *Carignane*, from Paso Robles station. Received November 4, 1893, in fair condition. The bunches were large, close, irregular, and heavily shouldered; the berries large, thick-skinned, very sweet, and commencing to dry. The must showed 25.9% of solid contents by spindle. The temperature of the grapes at crushing was 62°, and the maximum reached was 92°, on the third day. The murk was drawn off on the fifth day, while still sweet.

In one month the wine was still sweet, but clear. In two months it was bright, of good flavor and aroma, medium acid, and good body and astringency, still slightly subsweet. At six months it had been racked twice, and was of good quality, but not quite clean-tasting.

MATARO.

(See Vit. Rept. 1887–89, p. 192.)

This variety has been rather extensively planted, but, unfortunately, principally in the cooler parts of the coast valleys, to which it is least suited. At Mission San José, in the cooler parts of the Santa Clara Valley, in San Mateo County, and the lower parts of the valleys of Sonoma and Napa, it has been well tested, and though it generally yields good crops it is too late and gives a very harsh, low-bodied, common wine, is often deficient in sugar, and seldom ripens before the autumn rains begin. In the warmest localities of the Santa Clara Valley, in the Livermore Valley, and at the Asti Vineyard in the warm Cloverdale Valley, it has done better, bearing good crops, making a sound, solid, somewhat coarse wine, good for blending purposes in the production of ordinary wines. It seems, however, more adapted to the southern parts of the State; it has given excellent results in Los Angeles and San Diego counties. At Fresno and Tulare the vine lacks sufficient foliage, rendering the grapes subject to sunburn. At the Amador foothill station the grapes run low in acid, and give a wine that tends to the Port type. At Paso Robles the wine is lacking in color, tannin, and body, but as the vines are young these faults may decrease.

The average of seven analyses of this variety from the Bay region is 20.7% of sugar and 0.70% of acid; the body and tannin are very low for this same region. The average of four analyses of grapes from Amador station is 24.6% of sugar and 0.37% of acid, showing enough sugar but low acid. At Fresno the composition of the must has been fairly satisfactory, but at Tulare it has been very low in acid.

ANALYSES OF MUSTS AND WINES.

MATARO.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—No. 1252.	Fresno	Aug. 25	21.30	20.24	.53	.42	8.48	10.58	.104	.50	.43	2.32
No. 1255.	Amador County; G. A. Danet	Sept. 18	22.40	------	.41	.40	9.20	11.45	.156	.63	.50	2.58
1891—No. 1574.	Asti, Sonoma County	Oct. 7	23.05	22.67	.56	.36	9.70	12.09	.129	.55	.44	2.35
No. 1596.	Asti, Sonoma County	Oct. 18	25.00	23.04	.50	.31	10.81	13.27	.236	.93	.82	3.35
No. 1609.	Mountain View	Oct. 30	20.70	20.24	.78	.32	8.62	10.75	.143	.78	.52	2.55
No. 1610.	San José; Dr. Dudley	Nov. 1	22.08	21.80	.77	.40	9.20	11.45	.162	.74	.55	2.45
No. 1611.	Mountain View	Nov. 2	21.50	20.99	.70	------	9.20	11.45	.255	.71	.39	2.55
1892—No. 1727.	Paso Robles	Oct. 10	21.95	------	.47	------	------	------	------	------	------	------
1893—No. 1921.	Paso Robles	Oct. 12	22.60	20.99	.60	.23	8.13	10.17	.070	.58	.42	2.30
1894—No. 2172.	Amador station	Sept. 24	26.00	------	.33	------	------	------	------	------	------	------
No. 2313.	Tulare	Oct. 15	23.00	------	.28	------	------	------	------	------	------	------

COLOR READINGS.

MATARO.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.	
1891—No. 1574.	Asti, Sonoma County	24.4	4VR	15.5	5VR	7.8	1VR+Y	6.8	2VR+Y	------	------
No. 1596.	Asti, Sonoma County	125.0	2VR	70.0	5VR	48.6	4VR	47.6	5VR	32.5	5VR
No. 1596*a*.	Asti, Sonoma County	143.0	1VR	63.5	4VR	55.5	3VR	47.0	4VR	35.7	4VR
No. 1609.	Mountain View, San Mateo County	51.2	2VR	------	------	------	------	------	------	------	------
No. 1610.	San José; Dr. Dudley	51.2	1-2VR	------	------	------	------	------	------	------	------
1893—No. 1921.	Paso Robles	19.5	5VR	6.3	1R	4.1	3R	------	------	------	------

RECORD OF TREATMENT.

No. 1252. *Mataro*, from Margherita Vineyard, Fresno. Received August 27, 1890, in good condition. The bunches were large, the grapes large and mature. The must showed 21.3% of solid contents by spindle. The temperature of the grapes at crushing was 69°, and the maximum reached was 79°, on the fourth day. On the seventh day the murk was nearly dry, and was drawn off.

The wine was quite dry one week after pressing, but was some time in clearing. At two months it was bright, with light aroma, pleasing flavor, full acid, and medium astringency, very little color, neutral but agreeable. It was racked at one, three, and five months. The lees showed some *S. pastorianus* at four months. At eight months it was bright, and had improved; it possessed more character than No. 1251, Carignane. At seventeen months it was in good condition, and mature; it had lost almost all its color, and was neutral, with little bouquet, but clean taste. The wine was bottled, part at nineteen and part at twenty-nine months. At three years the wine first bottled was clear, sound, clean-tasting, lacking in delicacy; the second bottled was much inferior to the other, and had not kept well.

No. 1255, *Mataro*, from G. A. Danet, Amador County. These grapes were taken from six-year-old vines grown nearly on a hilltop, and well cultivated. Received September 20, 1890, in poor condition—loosely packed and much crushed. The bunches were of medium size and well filled. Many of the grapes were sunburnt. The must showed 22.4% of solid contents by spindle. The temperature of the grapes at crushing was 65°, and the maximum reached was 75°, on the fifth day. The fermentation was very sluggish, and the murk was drawn off on the seventh day while it was still sweet and fermenting.

In two weeks after pressing the wine was quite dry, but still cloudy. At two months it was clear and of marked and pleasing, but somewhat coarse, flavor and aroma, medium acid, good astringency and body. An examination of the lees at three months showed the presence of much *S. pastorianus.* At this date the wine was rough, but bright and sound, and was racked for the second time. After this it lost a little of its roughness, but though sound and agreeable was far from delicate. At fifteen months it was in good order and nearly mature. At sixteen months it was bottled. At three years the bottled wine was tasted, and found to be perfectly sound and in good order, clean-tasting and agreeable, but with little character; no deposit had been formed in the bottle.

No. 1574. *Mataro*, from Asti, Sonoma County. Received October 10, 1891, in good condition but for a little mold. The must showed 23.05% of solid contents by spindle. The temperature of the grapes at crushing was 61°, and the maximum reached was 82°. The murk was still a little sweet when drawn off on the seventh day.

The wine was nearly clear in five weeks, was without aroma, with little flavor, smooth, rather flat. In four months it was bright and somewhat improved, but its after-taste was not good. A month later it was in good order and a little improved, but without much character. After the second racking at ten months it continued to improve, and at sixteen months was smooth and well flavored. At eighteen months part of the wine was bottled. The part that was left in the cask deteriorated and acquired a bitter flavor. The remainder was bottled at twenty-two months. At three years and a half the bottled wine was tasted; it was bright, light in color, with some bouquet and flavor—a good, sound wine, not of high quality, but pleasing.

No. 1596. *Mataro*, from Asti, Sonoma County. Received October 21, 1891, in good condition. The grapes were mature and a few of them dried. The must showed 25.0% of solid contents by spindle. The grapes were divided into two parts of equal size; one part was fermented in the ordinary way, and the other was fermented according to Mr. Barth's system of close fermentation. The record of the ordinary fermentation is as follows: The temperature of the grapes at crushing was 67°, and the maximum reached was 80°, on the third day. The murk was still sweet on the fifth day, when it was drawn off.

In four days after pressing the wine was dry. It was somewhat slow in clearing. At five months it was bright, a coarse wine, tasting strongly of the stems. It was racked three times during the first fourteen months, and kept in good order. It remained sound and developed a little bouquet, but remained coarse, though a little smoother with age. It was bottled, part at eighteen months and part at twenty-two months. At three and one half years the bottled wine was bright, of good color, a little bouquet and flavor—a full, sound wine, with rather harsh acid, generally somewhat coarse, but good for blending. The later bottling was the better. No difference was perceptible in the wine fermented by Mr. Barth's process.

No. 1609. *Mataro*, from Mountain View, Santa Clara County. Received October 31, 1891, in poor condition. The must showed 20.7% of solid contents by spindle. The grapes were fermented with half the stems. The temperature of the grapes at crushing was 67°, and the maximum reached was 90°, on the third day. The murk was drawn off on the fourth day while still a little sweet, but on the sixth day was quite dry.

The wine was a little slow in clearing, but in two months was bright, sound, of good flavor, little aroma—good, but with little character. One month after the first racking the lees showed a few filaments, but as the wine tasted quite sound it was not pasteurized. At four months it was quite sound and had improved greatly, was a very fair, neutral wine. It was racked three times during the first year, and at fifteen months was smooth, pleasing, and mature. It kept well after this, but developed very little bouquet. At twenty-one months it was bottled. At three and one half years the bottled wine was sound and good, with little character or color, but smooth and agreeable.

No. 1610. *Mataro*, from Dr. Dudley, San José. Received November 4, 1891, in fair condition—bruised, but with only a very little mold. The must showed 22.08% of solid contents by spindle. The grapes were divided into two parts: (1) for white wine, 361 lbs. were crushed, pressed, and fermented as white wine; (2) for red wine, 488 lbs. were crushed and fermented on the skins, together with two and a half gallons of juice from that pressed for white wine. The fermentation of the red wine was cool, and a little slow; the temperature of the grapes at crushing was 67°, and the maximum reached was 87°, on the third day. On the sixth day, while the murk was still a little sweet, it was drawn off. The white wine commenced at the same temperature, and fermented slowly for nearly a month, at the end of which time it was dry. The maximum temperature reached was 76°, on the third day.

Mataro (white). At the end of six weeks the wine was clear, dry, schiller, very acid, and raw. It was racked five times during the first year, and remained bright and sound, but coarse. At the end of fifteen months it had lost its schiller tint, and was in good condition; it was, however, very coarse and rough, and generally not a success as a white wine. At seventeen months it was racked, and a portion put in glass. At three and a half years the bottled wine was bright, without deposit, a good neutral wine, with little character, but smooth and agreeable; would have been useful as a neutral blend.

Mataro (red). Two weeks after pressing, the wine was nearly clear and quite dry. At one month it was bright, very rough, and somewhat coarse. The wine was of good color, remained bright, and developed well, though slowly. At the end of a year it was in good condition, had been racked three times, and tasted sound, though the lees showed a little "graisse." The wine matured slowly, remained fresh and agreeable, and developed a slight but not unpleasant bitterness. It was racked three times during the second year, at the end of which some of it was bottled, though it did not taste quite mature. At the end of thirty-three months it was racked again, and another portion put in glass. At three and a half years the later bottling was bright, good, and sound, with little bouquet or flavor—a common but drinkable wine; the earlier bottling had more color and flavor, but was not so clean-tasting.

No. 1611. *Mataro*, from Mountain View. Received November 5, 1891, in good condition, wet by the rain. The must showed 21.5% of solid contents by spindle. The grapes were divided into two equal parts, one of which was fermented in the ordinary way with the addition of the stems, and the other according to Mr. Barth's method of close fermentation, also with the addition of the stems. The ordinary fermentation commenced at a temperature of 66°, and reached its maximum temperature of 87° on the third day. It was drawn off on the fourth day, when nearly dry. The close fermentation commenced at the same temperature of 66°, and reached a maximum of 82° on the second day. It was drawn off on the seventh day, while still a little sweet.

Mataro (*b*) (ordinary fermentation). At three weeks the wine was still cloudy and with a trace of sugar, perhaps a little more than No. 1611*a*. At six weeks it was racked, when it was clear, and little if at all distinguished from No. 1611*a*. Soon after this the lees showed a little lactic and the taste was slightly affected. At nine weeks it was pasteurized. At four months it was in good condition, a rough, strong wine, sound but with little flavor or aroma, and of mediocre quality. It was racked twice after this before it was fifteen months old, when it was in good condition, much toned down, and of rather good quality, but with little distinctive character. Part of it was bottled at this age. At twenty-one months it had changed very little, and was indistinguishable from No. 1611*a*. The remainder was bottled at this date. At three and one half years the bottled wines were tasted. The earlier bottling of the ordinary fermentation was the best; bright, with little deposit—a good wine, but not of high quality. The close fermented wine, bottled at the same time, had deposited heavily and was not as clean-tasting, showing a slower development. The later bottlings of each sample showed little difference.

Mataro (*a*) (closed fermentation). At three weeks the wine was still cloudy, and contained a trace of sugar. At six weeks it was clear, of good flavor, but without aroma, still slightly sweet. At six weeks it was in good condition and had a little bouquet, and though the lees showed a few filaments, the taste was unaffected. It was pasteurized for safety. After this the record is the same as for No. 1611*b*, except that at first it had a little more bouquet. At twenty-one months both wines were practically identical, as far as the taste went.

No. 1727. *Mataro*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The grapes were very small. The must showed 21.95% of solid contents by spindle.

No. 1921. *Mataro*, from Paso Robles station. Received October 12, 1893, in good condition. The bunches were small, rather compact; the berries small, sweet, quite mature. The must showed 22.6% of solid contents by spindle. The temperature of the grapes at crushing was 69°, and the fermentation lasted five days, at the end of which time the murk was drawn off dry.

In three weeks the wine was nearly clear, showed high acid and low astringency. It was racked twice during the first two months, when it was clear and smoother, but lacking in color. The quantity was too small to keep well, and after this the wine deteriorated. At seven months it was much inferior to the Grenache from the same locality.

MOURASTEL.

(See Vit. Rept. 1883-85, p. 106; 1887-89, p. 197.)

This variety has fully maintained its European reputation as a heavy bearer. It is a strong grower and bears well almost everywhere, and in some places, such as Tulare and Fresno, it bears immense crops. It ripens late, but somewhat earlier than the Mataro. At Mission San José it gives a good neutral wine, excellent for blending, but thin. At first it has good color, but the color is very unstable and is quickly dropped. The average of five analyses gave 21.9% of sugar and 0.78% of acid. At Cupertino the average of five analyses was 22.9% of sugar and 0.76% of acid.

At Tulare the vine is a good grower and produces very fine, large, and sound grapes; the must has averaged 21.3% of sugar and 0.61% of acid, and ferments well. It produces a sound neutral wine, very similar to that of the Carignane of the same locality and with the same defects, viz., almost total lack of color, and low tannin.

At Paso Robles the grapes attain more sugar and sufficient acid. The variety is promising for this locality, though the color is somewhat at fault. The must has from medium to high percentages of acid in all localities, and is a good fermenter.

ANALYSES OF MUSTS AND WINES.

MOURASTEL.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—No. 1326.	Cupertino	Oct. 11	18.40	------	1.37	.31	7.57	9.45	.099	.81	.62	2.32
No. 1330.	Mission San José	Oct. 11	21.50	------	.99	.24	8.62	10.75	.191	.78	.52	2.75
1891—No. 1439.	Tulare	Aug. 24	19.70	------	.64	------	------	------	------	------	------	------
No. 1471.	Fresno	Aug. 28	20.85	19.89	.80	.65	8.13	10.17	.168	.63	.53	2.70
No. 1528.	Paso Robles	Oct. 5	20.60	20.24	.62	.34	------	------	------	------	------	------
No. 1569.	Mission San José	Oct. 6	21.70	------	.90	------	8.77	10.91	.152	.88	.52	2.75
1892—No. 1690.	Tulare	Sept. 26	21.50	21.38	.41	.33	8.55	10.67	.143	.48	.50	2.80
No. 1759.	Paso Robles	Oct. 11	23.70	------	.46	------	------	------	------	------	------	------
1893—No. 1863.	Amador station	Sept. 13	21.10	------	1.03	------	------	------	------	------	------	------
No. 1898.	Tulare	Sept. 28	22.00	20.99	.71	.33	8.13	10.17	.087	.69	.47	2.45
No. 2045.	Cupertino	Nov. 1	24.35	------	.86	------	------	------	.234	.93	------	------
No. 2071.	Paso Robles	Nov. 3	24.25	23.91	.50	.33	9.56	11.91	.166	.63	.45	2.80
No. 2074.	Mission San José	Nov. 3	22.10	20.99	.83	.23	8.48	10.58	.163	.78	.53	2.30
1894—No. 2176.	Amador station	Sept. 24	24.40	------	.49	------	------	------	------	------	------	------
No. 2278.	Tulare	Oct. 5	22.60	21.38	.50	------	------	------	.139	.55	.45	2.60
No. 2343.	Mission San José	Oct. 24	20.40	------	.57	------	------	------	.133	.58	------	------

COLOR READINGS.

MOURASTEL.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.	
1891—No. 1471.	Fresno	9.6	R	5.5	2R	4.1	4VR+Y	------		------	
No. 1569.	Mission San José	111.1	1VR	24.0	1R	------		------		------	
1892—No. 1690.	Tulare	14.2	5VR	9.5	1VR+Y	5.5	2R+Y	------		------	
1893—No. 1898.	Tulare	11.7	5VR	4.2	5VR+Y	------		------		------	
No. 2045.	Cupertino	56.3	VR	------		------		------		------	
No. 2071.	Paso Robles	30.8	3VR	15.4	R	10.4	R	10.5	5VR	9.3	R
No. 2074.	Mission San José	70.2	3VR	52.0	2VR	52.7	2VR	44.9	1-2VR	26.3	3VR
1894—No. 2278.	Tulare	11.5	2R	6.0	1R	5.2	3R+Y	------		------	
No. 2343.	Mission San José	39.2	4VR	------		------		------		------	

Record of Treatment.

No. 1326. *Mourastel*, from Cupertino. Received October 13, 1890, in fair condition, but not mature. The must showed 18.4% of solid contents by spindle. The temperature of the crushed grapes was 65°, and the maximum reached was 92°, on the fourth day. The murk was still a little sweet on the fifth day, and was drawn off on the sixth.

Three weeks after pressing the wine was nearly clear, very acid, and light in color. At three months it was racked for the second time; the lees showed much *S. pastorianus*; the wine was quite bright, of good bouquet and flavor, high acid, medium body and astringency, vinous, and clean-tasting; it was of fairly good quality, but thin and green, and after six months deteriorated rapidly. In a year it had lost nearly all its color and quality.

No. 1330. *Mourastel*, from Mission San José. Received October 14, 1890, in good condition, and mature. The must showed 21.5% of solid contents by spindle. The temperature of the grapes at crushing was 66°, and the maximum reached was 96°, on the fourth day, when, being nearly dry, the murk was drawn off.

The wine was somewhat slow in clearing, but in two months was clear and of fair quality; it had very little aroma and a neutral flavor, full acid, and medium astringency. It developed well, and at six months had improved much, the bouquet and flavor were marked and pleasing, the acid a little high. The lees showed a good deal of *S. pastorianus*. At fifteen months the wine was in good order, very fresh and pleasing, but not quite mature. At sixteen months part of the wine was bottled, and the rest bottled at twenty-six months. At thirty-nine months both wines were tasted; the first bottling had not kept well, but the second was in first-class order, with good flavor and bouquet, a smooth and agreeable wine.

No. 1439. *Mourastel*, from Tulare station. Received August 27, 1891, in good condition. The must showed 19.7% of solid contents by spindle. Only a small sample for must analysis was received.

No. 1471. *Mourastel*, from Margherita Vineyard, Fresno. Received September 1, 1891, in good condition. The must showed 20.85% of solid contents by spindle. The temperature of the grapes at crushing was 70°, and the maximum reached was 84°, on the fourth day. The fermentation was slow and the murk was still sweet when it was drawn off on the seventh day.

In two weeks the wine was nearly, and in six weeks quite, dry and clear; it was clean-tasting, with full acid and astringency, but little flavor or aroma. At four months the lees showed a little acetic ferment and some *S. pastorianus;* the wine was clear, clean-tasting, with little character, and showed signs of maturing quickly. It soon became bright and continued to improve up to seventeen months, becoming a light and agreeable wine, but lacking in quality and vinosity. Part of the wine was bottled at nineteen months, after which the rest, which was left in wood, deteriorated. More of the wine was bottled at twenty-three months. At three and one half years the wine of both bottlings was bright and very much improved, lacking in color and character, but good and clean-tasting, with no deposit, and perfectly mature; a good, neutral, blending wine. Some wine bottled at twelve months was spoiled.

No. 1528. *Mourastel*, from Paso Robles station. Received October 7, 1891, in good condition. The must showed 20.6% of solid contents by spindle. The grapes were fermented with No. 1527, Grenache.

No. 1569. *Mourastel*, from Mission San José. Received October 9, 1891, in good condition, but somewhat sunburnt. The must showed 21.7% of solid contents by spindle. The temperature of the must at crushing was 60°, and the maximum reached was 87°, on the fourth day. The murk was nearly dry on the fifth day, when it was drawn off.

At one month the wine was clear and showed good acid and astringency. At four months the lees showed a little "graisse," but the wine was bright, of good flavor, with some bouquet and generally much improved. At five months it was in good order and maturing well; it showed full acid and increased bouquet. A month later the lees were examined, and showed much *S. pastorianus*. At sixteen months it was good, clean-tasting, and mature. At this age part was bottled and the rest left in wood, where it kept perfectly and was bottled at twenty-two months. At three and a half years the later bottled wine was bright, light in color, without bouquet and with little flavor, high acid, a clean-tasting wine, but lacking character; the earlier bottled had rather more color and flavor.

No. 1690. *Mourastel*, from Tulare station. Received September 29, 1892, in good condition. The must showed 21.5% of solid contents by spindle. The temperature of the must at crushing was 69°, and the maximum reached was 87°, on the third day. The murk was still a little sweet on the fourth day, and was drawn off on the fifth.

In one month after crushing the wine was nearly clear and quite dry. At three months it was bright, of good flavor, full astringency, somewhat coarse, but sound and good. After this the wine remained in good order and became smoother, but did not develop any bouquet. At fourteen months it was quite sound and nearly mature, but had lost nearly all its color. At eighteen months it was bottled.

No. 1759. *Mourastel*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 23.7% of solid contents by spindle.

No. 1863. *Mourastel*, from Amador station. A sample for must analysis was received September 15, 1893, in poor condition; the grapes were very small, diseased, and not ripe.

No. 1898. *Mourastel*, from Tulare station. Received September 28, 1893, in good condition. The bunches were very large, irregular, and compact; the berries large, sound, and very fine in appearance, with thick skins, but little color. The must showed 22.0% of solid contents by spindle. The temperature of the grapes at crushing was 66°, and the maximum reached was 94°, on the fourth day. The murk was dry on the fifth day, when it was drawn off.

The wine was a little slow in clearing. A month after pressing it was nearly clear, clean-tasting, but without flavor or color. At five months it was clear, clean-tasting, with medium acid and astringency, little character, altogether a fairly drinkable wine. Being in a sixty-gallon keg it was much less advanced than other wines in smaller quantities. At this age it was racked into two twenty-five-gallon kegs. At nine months it was in good order, improved in flavor, and quite sound.

No. 2045. *Mourastel*, from J. T. Doyle, Cupertino. A sample for must analysis and for color and tannin tests was received October 31, 1893, in good condition. The bunches were over medium in size, irregular, short-conical, close; the berries over medium in size, pulpy, soft, mature, with little flavor. The must showed 24.35% of solid contents by spindle.

No. 2071. *Mourastel*, from Paso Robles station. Received November 3, 1893, in fair condition. The bunches were of medium size, conical, shouldered, compact; the berries over medium in size, round, thick-skinned, soft, overripe. The must showed 24.25% of solid contents by spindle. The temperature of the must at crushing was 62°, and the maximum reached was 80°, on the fourth day. The murk was dry on the sixth day, when it was drawn off.

In one month from pressing the wine was clear. In two months it was clear, rough, and astringent, with medium acid, good body, and coarse flavor. At six months it had been racked twice, and was much improved, still rough, but clean-tasting, and with good keeping qualities. At nine months it had changed little and still showed a trace of sugar, though quite sound. An examination of the lees showed the presence of *S. pastorianus*.

No. 2074. *Mourastel*, from Mission San José. Received November 3, 1893, in good condition. The bunches were over medium in size, conical, shouldered, compact; the berries of medium size, soft, thick-skinned, mature. The must showed 22.1% of solid contents by spindle. The temperature of the grapes at crushing was 61°, and the maximum reached was 89°, on the third day. The murk was dry on the fourth day, when it was drawn off.

The wine was clear within one month after pressing, and was racked twice during the first three months. At six months it was bright, with little bouquet, good flavor, medium astringency, full acid, clean taste—a good wine, but not of high quality. At nine months it was sound and in good order.

BECLAN.

(See Vit. Rept. 1883–85, p. 91; 1886, p. 73.)

For certain soils and locations this variety is more valuable than its limited distribution would seem to indicate. It is especially adapted to cooler localities and to fairly strong soils. Under these conditions it bears about three tons to the acre with short-pruning, shades its grapes sufficiently, and is very free from disease. In warmer localities or lighter soils it is less vigorous and deficient in foliage, rendering its grapes liable to sunburn. The bunches are regular, of medium size, long conico-cylindrical, with small shoulders and often a small wing, compact but not so much so as to press the berries out of shape or prevent the free circulation of air; the berries are under medium size, round, crisp, juicy, thick-skinned and not easily injured, and with a fresh and agreeable taste.

The grapes ripen earlier than the Cabernets, and a little later than the Pinots, attaining a good percentage of sugar (23% to 25%) with medium acid (0.40% to 0.50%). These figures refer to results obtained at Mission San José and Paso Robles. In warmer places, such as Tulare, the must is deficient in acid. In the rich soil of Tulare the vine grows vigorously where the alkali is not too strong, but does not bear well. The must from grapes grown at Mission San José ferments somewhat slowly but thoroughly, and makes a very good wine, of medium acid and tannin, sufficient color and clean taste. It requires, however, the addition of some Cabernet or similar grape, as, when alone, it lacks character. It has, in fact, a peculiar taste when pure, which is hardly agreeable, but which disappears with proper blending.

Analyses of Musts and Wines.

BECLAN.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
							By Weight	By Volume		At Pressing	At 6 to 8 Months	
1893—No. 1927.	Paso Robles	Oct. 12	23.25	22.04	.50	.25	------	------	.259	.47	------	------
No. 1967.	Tulare	Oct. 16	24.80	23.42	.23	.36	9.20	11.48	.138	.42	.44	3.20
1894—No. 2273.	Mission San José	Oct. 3	23.70	22.90	.45	------	------	------	------	.47	------	------
No. 2314.	Tulare	Oct. 13	24.50	------	.33	------	------	------	------	------	------	------

Color Readings.

BECLAN.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1893—No. 1927.	Paso Robles	54.8	VR	26.1	3VR	------	------	------	------	------	------	------	------
No. 1967.	Tulare	36.7	VR	29.6	1VR	19.5	3VR	17.1	5VR	6.2	(Y)	5.0	(Y)
1894—No. 2273.	Mission San José	70.8	1VR	60.6	1VR	49.4	1VR	19.0	4VR	------	------	------	------
No. 2273*a*.	Mission San José	30.5	VR	23.1	VR	16.0	1VR	12.1	4VR	------	------	------	------

RECORD OF TREATMENT.

No. 1927. *Beclan*, from Paso Robles station. A sample for must analysis and for tannin and color tests was received October 12, 1893, in good condition. The bunches were small, narrow, cylindrical, very regular, and compact; the berries very small, round, juicy, somewhat shriveled, but with good acid. The must showed 23.25% of solid contents by spindle.

No. 1967. *Beclan*, from Tulare station. Received October 16, 1893, in good condition. The bunches were small, cylindrical, and close; the berries round, small, very sweet, and some of them dried. The must showed 23.42% of solid contents by spindle. The initial temperature of the must was 68°, and the maximum of 83° was reached on the third day. The fermentation was over on the fifth day.

In one month the wine was clear, clean-tasting, and of good flavor. At three months it was bright, smooth, and agreeable. At six months it retained its good quality, but was lacking in color.

PETIT BOUSCHET.

(See Vit. Rept. 1883–85, p. 109; 1887–89, p. 226.)

As a variety for the production of cutting wines at the Bay region stations this variety seems to be inferior to the Alicante Bouschet in everything but bearing and body. The average composition of the must at these stations has been: Sugar, 21.3%; acid, 0.77%; tannin, 0.414%, and body, 3.31%. This would indicate a wine excellent to blend with such a wine as that of the Beclan, which has flavor, delicacy, and full alcohol, but is lacking in color, tannin, and robustness. But for general purposes the Alicante would be preferable.

At Tulare the vines of this variety are growing in a somewhat alkaline, sandy soil; they are strong growers, with good foliage and are heavy bearers. From six to twelve tons per acre have been obtained, of very sound, well-ripened grapes. The must is rather low in sugar, but has sufficient acid. It has always fermented well and made a good, sound wine, not of high quality, but good for blending purposes. The wine has had sufficient color for itself, but not enough to be of use to blend with a wine lacking in color. In this respect it has fallen below Gros Mansenc, St. Macaire, and Barbera, and has been equaled by Refosco and Charbono. The wine is somewhat richer in tannin than that of Barbera, but falls below that of Refosco.

Analyses of Musts and Wines.

PETIT BOUSCHET.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—No. 1245.	Fresno	Aug. 24	24.70	25.76	.51	.41						
No. 1378.	Mission San José	Oct. 18	23.50		.80	.39	9.12	11.36	.485	.83	.37	3.32
No. 1394.	Cupertino	Oct. 18	23.70		.69							
1891—No. 1435.	Tulare	Aug. 24	22.20	22.05	.53	.50	8.84	11.00	.227	.43	.45	3.12
No. 1529.	Paso Robles	Oct. 5	20.05		.51	.45						
1892—No. 1627.	Tulare	Sept. 3	22.20	21.38	.57	.45	8.41	11.09	.185	.58	.50	3.05
No. 1745.	Paso Robles	Oct. 11	20.40		.51							
No. 1778.	Mission San José	Oct. 13	21.60	21.80	.92							
1893—No. 1882.	Tulare	Sept. 15	21.20	19.54	.65	.32	8.07	10.03	.221	.48	.52	2.85
No. 2009.	Paso Robles	Oct. 26	24.80	24.12	.47	.29	9.56	11.91	.480	.48	.47	3.10
No. 2048.	Cupertino	Nov. 1	20.40		.80				.473			
No. 2120.	Cupertino	Nov. 7	18.60		.84				.502			
1894—No. 2168.	Tulare	Sept. 20	22.30	21.80	.43		8.48	10.58	.298	.55	.35	2.85
No. 2226.	Mission San José	Oct. 4	19.70	19.21	.73		6.42	8.07	.266	.77	.62	3.30
No. 2293.	Mission San José	Oct. 12	21.50		.58		7.64	9.54	.345		.49	3.50

Color Readings.

PETIT BOUSCHET.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.		Six Months.	
1891—No. 1435.	Tulare	15.5	2R	11.6	3VR+Y	7.1	1R+Y	6.4	1R+Y	7.1	2R+Y	8.3	3R+Y		
1892—No. 1627.	Tulare	38.4	4VR	21.5	5VR	12.9	1R	11.4	1R	11.8	2R	11.4	2R	11.4	2R
1893—No. 1882.	Tulare	57.1	2VR	37.0	5VR	20.6	R-1R	22.3	R	19.1	1R	16.9	1R		
No. 2009.	Paso Robles	118.0	VR	64.5	2VR	55.5	2VR	50.6	2VR	40.4	3VR				
No. 2048.	Cupertino	166.0	1-2VR												
No. 2120.	Cupertino	133.0	3VR												
1894—No. 2168.	Tulare	48.8	2VR	18.6	R	19.0	R	16.2	R						
No. 2226.	Mission San José	105.0	2VR	75.5	1VR	64.5	1VR	42.5	1VR						
No. 2293.	Mission San José	154.0	VR-1VR	95.2	VR	86.9	1VR	42.5	1VR						

RECORD OF TREATMENT.

No. 1245. *Petit Bouschet*, from Margherita Vineyard, Fresno. Received August 26, 1890, in good condition, and mature. The must showed 24.7% of solid contents by spindle and 0.51% of acid. The grapes were mixed with No. 1241, Alicante Bouschet, from the same vineyard.

No. 1378. *Petit Bouschet*, from Mission San José. Received October 20, 1890, in good condition, but overripe and shriveled. The must showed 23.5% of solid contents by spindle and 0.80% of acid. The temperature of the must at crushing was 69°, and the maximum reached was 96°, on the third day. On the fourth day the murk was dry, and was drawn off.

In one month the wine was clear, very raw and astringent, and of very intense color. At three months it was bright and had been racked twice. It had no bouquet, and tasted flat and a little suspicious. An examination of the lees showed the presence of filaments, so the wine was pasteurized. At two months after pasteurizing it was clear, had improved in flavor, developed a little bouquet, and was generally improved. It was of fair quality, but heavy-bodied, very astringent, and coarse. After this it did not improve much, and at seventeen months part of it was put in bottle; at twenty-three months the rest was bottled. At twenty-seven months that first bottled was spoiled; the second was bright, of intense color and good tint, but not of high quality.

No. 1394. *Petit Bouschet*, from Cupertino. A sample for must analysis was received October 21, 1890, in fair condition, but somewhat shriveled and overripe. The must showed 23.7% of solid contents by spindle and 0.69% of acid.

No. 1435. *Petit Bouschet*, from Tulare station. Received August 27, 1891, in good condition; the juice was but slightly colored. The must showed 22.2% of solid contents by spindle and 0.53% of acid. The temperature of the must at crushing was 66°, and the maximum reached was 85°, on the fourth day. On the afternoon of the fourth day the murk was dry, and was drawn off.

In three weeks the wine was nearly clear and quite dry, but very rough and not agreeable. A month later it was clear and sound, but of poor quality and little color. At four months it had been racked twice, and was in good order, with little flavor, but clean taste; in general, was much improved. After this it soon deteriorated, being in a very small keg; and at seven months the lees showed acetic germs and filaments. At nine months it was no longer worth keeping.

No. 1529. *Petit Bouschet*, from Paso Robles station. A sample for must analysis was received October 7, 1891, in good condition. The must showed 20.05% of solid contents by spindle and 0.51% of acid.

No. 1627. *Petit Bouschet*, from Tulare station. Received September 6, 1892, in good condition; the bunches were large and well filled. The must showed 22.2% of solid contents by spindle and 0.57% of acid. The temperature of the must at crushing was 68°, and the maximum reached was 90°, on the third day. On the fifth day the murk was drawn off while still fermenting.

One month after pressing the wine was nearly clear and quite dry. At four months it was bright, not of very pleasing odor, but of good flavor, and generally a good wine. Three months later it was in good condition and the bouquet had much improved. At nine months it had been racked three times and had changed very little since the last tasting. At eleven and at fifteen months it was in good condition—an agreeable wine and perfectly sound, but very light in color for a Bouschet. At nineteen months it was bottled. At three and one half years the bottled wine was bright, of sufficient color, with rather more character than the Refosco of the same locality, but not quite so clean-tasting.

No. 1745. *Petit Bouschet*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 20.4% of solid contents by spindle and 0.51% of acid.

No. 1778. *Petit Bouschet*, from Mission San José. Received October 15, 1892, in good condition. The must showed 21.6% of solid contents by spindle and 0.92% of acid. The grapes were fermented with No. 1767, Herbemont, from the same vineyard.

No. 1882. *Petit Bouschet*, from Tulare station. Received September 17, 1893, in good condition. The bunches were short, irregular, of medium size, well filled, but not compact; the berries were large and well colored, but the juice not very red. They were the healthiest and finest red grapes yet received from Tulare. Most of the grapes were mature, but a few bunches were rather green and seemed to be second crop, though as large as the others. The must showed 21.2% of solid contents by spindle and 0.65% of acid. The temperature of the grapes at crushing was 67°, and the maximum reached was 93°, on the third day. On the fourth day the murk was dry, and was drawn off.

The wine remained cloudy for six weeks, and tasted flat. In two months it was nearly clear, and was racked and taken to the cellar. At six months it was clear, with some bouquet and flavor, medium acid and astringency, enough color for a red wine, but very little for a Bouschet. At twelve months it was in good order, with more color and flavor than the Mourastel of the same vineyard and year, but not quite so clean-tasting.

No. 2009. *Petit Bouschet*, from Paso Robles station. Received October 26, 1893, in good condition. The bunches were large, winged, and well filled, on large peduncles; the berries of medium size, round, firm, very sweet, and with deep red juice; some berries were dried. The must showed 24.8% of solid contents by spindle and 0.47% of acid. The temperature of the grapes at crushing was 62°, and the maximum reached was 87°, on the third day. On the sixth day the murk was nearly dry, and was drawn off.

In one month the wine was clear, and was racked and taken to the cellar. In three months it was bright, of good flavor and aroma, very astringent, with medium acid—a good, sound wine, but very rough. Tastings at six and at nine months showed a gradual improvement. The wine remained in good order, and at nine months was possessed of flavor and aroma, but was still sub-sweet and very immature.

No. 2048. *Petit Bouschet*, from Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were over medium in size, conical and close; the berries of medium size, were very juicy, and the juice deeply colored, and mature. The must showed 20.4% of solid contents by spindle and 0.80% of acid.

ALICANTE BOUSCHET.

(See Vit. Rept. 1887-89, p. 224.)

This variety has shown itself to be one of the most "solid" wines yet tested. With a good amount of sugar, it has high acid, tannin, and body, being equal in these respects to any of the North Italian varieties. Leaving out of consideration the grapes from grafts of one year, which are not typical, the average composition of the must of this variety for three years, as grown in the Bay region, is 24.2% of sugar and 0.98% of acid. Of the three wines made during this time, the average tannin content was 0.492%, and the body of the only one determined was 3.05%. The wine, when made up alone, is too heavy to be agreeable, but it is clean-tasting, and as a blend for thin wines would be hard to excel. At Fresno this grape has not done well, but was not sufficiently investigated and is worthy of further trial.

From Oakville, Napa County, the Alicante Bouschet is reported as giving a "thin wine of good quality," and as being occasionally subject to coulure. In the St. Helena and Alhambra valleys it has given satisfaction, yielding good crops of grapes excellent for blending purposes. The grapes ripen at about the same time as the Zinfandel, and, though sometimes not ripening very evenly, they are much more resistant than the latter.

ANALYSES OF MUSTS AND WINES.

ALICANTE BOUSCHET.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
						By Weight	By Volume		At Pressing	At Six Months	
1890—No. 1241. Fresno	Aug. 24	22.15	20.61	.71	.42	9.05	11.27	.214	------	.53	2.82
No. 1396. Cupertino	Oct. 19	25.90	------	1.02	------	------	------	------	------	------	------
1891—No. 1581. Mission San José	Oct. 13	24.35	22.67	.77	.43	9.56	11.91	.398	.72	.50	3.05
1892—No. 1790. Mission San José	Oct. 18	23.70	------	.81	------	------	------	------	------	------	------
1893—No. 2046. Cupertino	Oct. 30	23.70	------	1.25	------	------	------	.604	1.31	------	------
No. 2112. Cupertino	Oct. 30	23.10	------	1.03	------	------	------	.474	.83	------	------

COLOR READINGS.

ALICANTE BOUSCHET.	At Pressing.	One Month.	Two Months.	Three Months.	Four Months.	Five Months.	Ten Months.
1890—No. 1241. Fresno	48.6 3VR	25 4VR	25.7 4-5VR	19.3 2R	14.6 1-2R	13.1 2R	13.1 3VR+Y
1891—No. 1581. Mission San José	363.0 VR	235 1VR	114.3 1VR	118.3 1VR	105.3 1VR	------	------
1893—No. 2046. Cupertino	190.0 1VR	------	------	------	------	------	------
No. 2112. Cupertino	148.0 1VR	------	------	------	------	------	------

RECORD OF TREATMENT.

No 1241. *Alicante Bouschet*, from Margherita Vineyard, Fresno. Received August 25, 1893, in fair condition. The bunches were large, pyramidal, and sometimes shouldered, on slender but tough peduncles; the berries were round, variable in size, on long, tough pedicels; the grapes were crisp, juicy, and mature. The must showed 22.15% of solid contents by spindle, and 0.71% of acid. The grapes were fermented with No. 1245, Petit Bouschet, in the proportion of 73% of Alicante to 27% of the other. The temperature of the must at starting was 66°, and the maximum reached was 92°, on the third day. On the fifth day the murk was dry, and was drawn off.

The wine was slow in clearing, and fermented quietly for several weeks. At two months it was nearly clear, but tasted a little suspicious. At three months the wine was racked, and taken to the cellar; a little later an examination of the lees showed the presence of filaments, and the wine was pasteurized. After pasteurizing it became clear, but the taste was affected by the secondary fermentation. At nineteen months it was bright, much improved in taste, and quite mature. It was racked for the fourth time, and some of it bottled. When it was two years old it was all bottled. At three and one half years the wine first bottled was spoiled; that bottled later was bright and in good order, but flat and of poor quality.

No. 1396. *Alicante Bouschet*, from Cupertino. A sample for must analysis was received October 21, 1890, in bad condition—shriveled and moldy. The must showed 25.9% of solid contents by spindle and 1.02% of acid.

No. 1581. *Alicante Bouschet*, from Mission San José. Received October 16, 1891, in poor condition, and not quite mature. The must showed 24.35% of solid contents by spindle and 0.77% of acid. The temperature of the grapes at crushing was 69°, and the maximum reached was 82°, on the third day. On the fourth day the murk was dry, and was drawn off.

At one month the wine was clear, with some aroma and good flavor, full astringency, and good acid. During the first three months it was racked twice, and at the end of that time the lees were examined and found to be sound. At five months it was bright, a round, full-bodied wine, of neutral character, maturing quickly. At seven months it was very smooth and agreeable, but with plenty of tannin. At ten months it was bottled. At three and one half years the bottled wine was bright, of intense color, some bouquet, and good flavor. It was a very heavy but clean-tasting wine—a model blend for improving wines lacking in body, tannin, and color.

No. 1790. *Alicante Bouschet*, from Mission San José. Received October 21, 1892, in poor condition. The must showed 23.7% of solid contents by spindle and 0.81% of acid. The grapes were fermented with No. 1789, Cinsaut, from the same vineyard.

No. 2046. *Alicante Bouschet*, from Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were of medium size, irregular, winged, loose, coulured; the berries of medium size, juicy, thick-skinned, with good acid and white juice; the grapes were mature. The must showed 23.7% of solid contents by spindle and 1.25% of acid.

No. 2112. *Alicante Bouschet*, from Cupertino. A sample for must analysis was received November 1, 1893, in good condition. The must showed 23.1% of solid contents by spindle and 1.03% of acid.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF SOUTHERN FRENCH TYPE.

Number	LOCALITY.	Vintage of	MUST. Solid Contents by Spindle	MUST. Sugar by Copper Test	MUST. Acid as Tartaric	MUST. Ash	WINE. Alcohol by Volume	WINE. Tannin	WINE. Total Acid as Tartaric. At Pressing	WINE. Total Acid as Tartaric. At 6 to 8 Months	WINE. Body
	Aramon.										
1246	Fresno	1890	21.10	20.99	.65	.36	10.58	.248	.50	.39	2.82
1474	Fresno	1891	21.50	--------	.57	------	10.42	.210	.66	.44	2.60
1377	Mission San José	1890	22.10	--------	.81	.29	11.45	.149	.71	.36	2.58
2299	Mission San José	1894	22.80	--------	.61	------	--------	.147	.72	--------	------
1414	Cupertino	1890	23.00	--------	.51	.22	12.18	.298	.62	.44	2.82
2054	Cupertino	1893	23.40	--------	62	------	--------	.345	.79	--------	------
1436	Tulare	1891	20.20	--------	.53	------	--------	--------	--------	--------	------
1639	Tulare	1892	21.50	20.44	.57	.34	11.00	.242	.53	.44	2.65
1918	Tulare	1893	21.50	19.21	.74	.44	9.90	.147	.68	.47	2.60
2290	Tulare	1894	22.85	21.80	.48	------	10.58	.052	.56	--------	2.65
" (*a*)	Tulare	1894	22.85	21.80	.48	------	10.75	.285	.42	.58	2.60
1659	Amador station	1892	20.30	--------	.76	------	--------	--------	--------	--------	------
1826	Amador station	1893	18.60	--------	.86	.23	--------	.182	.86	--------	------
2178	Amador station	1894	20.40	--------	.67	------	--------	--------	--------	--------	------
2316	Amador station	1894	23.40	--------	.45	------	--------	--------	--------	--------	------
1755	Paso Robles	1892	21.50	--------	.48	------	--------	--------	--------	--------	------
	Average, Fresno	------	**21.30**	**20.90**	**.61**	**.36**	**10.50**	**.229**	**.58**	**.42**	**2.71**
	Average, Mission San Jose	------	**22.45**	--------	**.71**	**.29**	**11.45**	**.148**	**.72**	**.36**	**2.58**
	Average, Cupertino	------	**23.20**	--------	**.57**	**.22**	**12.18**	**.322**	**.71**	**.44**	**2.82**
	Average, Tulare	------	**21.78**	**20.81**	**.56**	**.39**	**10.56**	**.181**	**.55**	**.49**	**2.62**
	Average, Amador station	------	**20.69**	--------	**.68**	**.23**	--------	**.182**	**.86**	--------	------
	Cinsaut.										
1408	Mission San José	1890	22.35	--------	.44	.21	12.36	.122	--------	.41	2.58
1789	Mission San José	1892	22.10	--------	.53	------	--------	--------	--------	--------	------
2307	Mission San José	1894	20.85	--------	.44	------	--------	--------	--------	--------	------
1434	Tulare	1891	25.20	24.22	.52	.64	12.00	.120	.42	.30	3.80
1614	Tulare	1892	22.05	22.24	.58	------	10.90	.103	.43	.47	2.95
1842	Tulare	1893	21.95	20.24	.62	.37	11.00	.083	.52	.49	2.60

SUMMARY OF ANALYSES OF MUSTS AND WINES OF SOUTHERN FRENCH TYPE—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At 6 to 8 Months	Body
	Cinsaut—Continued.										
2138	Tulare	1894	22.00	21.38	.47		10.58	.136	.42	.42	2.60
1477	Paso Robles	1891	18.60		.58						
1655	Paso Robles	1892	22.60		.57						
1825	Amador station	1893	21.05		.69			.284	.83		
2159	Amador station	1894	26.50		.45						
2050	Cupertino	1893	19.10		.61			.467	.79		
	Average, Mission San Jose		**21.77**		**.47**	**.21**	**12.36**	**.120**	**.42**	**.30**	**3.80**
	Average, Tulare		**22.80**	**22.02**	**.55**	**.50**	**11.12**	**.110**	**.45**	**.42**	**2.99**
	Average, Paso Robles		**20.60**		**.58**						
	Average, Amador station		**23.88**		**.57**			**.284**	**.83**		
	Grenache.										
1249	Fresno	1890	24.10	23.72	.57	.40	12.07	.153	.55	.46	3.02
1333	Cupertino	1890	24.35		.62						
1444	Tulare	1891	22.60		.53						
1626	Tulare	1892	23.25	23.13	.47	.35	11.73	.172	.55	.48	2.90
1845	Tulare	1893	22.80	20.61	.53	.33	11.00	.109	.52		2.70
2170	Tulare	1894	25.10	24.97	.47		12.91	.150	.40	.44	2.85
1527	Paso Robles	1891	24.40	24.12	.45		12.09	.180		.40	2.55
1721	Paso Robles	1892	22.60	22.23	.56	.45	11.27	.146	.50	.55	2.85
2010	Paso Robles	1893	28.20	27.65	.51	.29	13.54	.224	.51	.60	2.85
1822	Amador station	1893	23.25		.74			.288	.80		
2193	Amador station	1894	28.00		.46						
	Average, Tulare		**23.44**	**22.90**	**.50**	**.34**	**11.88**	**.144**	**.49**	**.46**	**2.82**
	Average, Paso Robles		**25.07**	**24.67**	**.51**	**.37**	**12.30**	**.183**	**.51**	**.52**	**2.75**
	Average, Amador station		**25.63**		**.60**			**.288**	**.80**		

	Ploussard.										
1261	Mission San José	1890	24.80		.55	.34	12.18	.115	.46	.41	2.95
1505	Mission San José	1891	25.30	25.41	.45		12.64	.188	.41	.42	3.05
1637	Mission San José	1892	22.00		.57						
1983	Mission San José	1893	25.90	24.75	.56		13.27	.182	.58	.61	2.80
1291	Cupertino	1890	25.10		.57	.21					
	Average, Mission San Jose		**24.50**	**25.08**	**.53**	**.34**	**12.69**	**.162**	**.48**	**.48**	**2.93**
	Trousseau.										
1204	Fresno	1890	22.27	22.05	.58	.52	11.00	.084	.47	.43	2.60
1458	Fresno	1891	27.65		.61		19.28	.160	.56	.20	6.85
1498	Asti, Sonoma County	1891	24.60	23.13	.41	.39	12.18	.065		.47	2.70
1510	Mission San José	1891	25.20	26.31	.53						
1925	Paso Robles	1893	26.90	26.12	.26	.34		.176	.38		
2335	Tulare	1894	26.80		.30						
	Bastardo.										
1354	Cupertino	1890	25.77		.44						
2017	Cupertino	1893	28.00		.63			.252	.75		
1479	Paso Robles	1891	22.90		.43						
1641	Paso Robles	1892	22.15		.64						
1865	Paso Robles	1893	23.90	22.95	.49	.34	11.48	.151	.38	.40	2.80
1625	Tulare	1892	24.80		.41						
2149	Tulare	1894	26.50		.41						
1709	Mission San José	1892	23.70	22.95	.85	.26					
2266	Mission San José	1894	25.90		.47						
1834	Amador station	1893	24.80		.72			.358	.68		
	Average, Cupertino		**26.89**		**.54**			**.252**	**.75**		
	Average, Paso Robles		**22.98**	**22.95**	**.52**	**.34**	**11.48**	**.151**	**.38**	**.40**	**2.80**
	Average, Tulare		**25.65**		**.41**						
	Average, Mission San Jose		**27.20**		**.68**	**.26**					
	Chauché noir.										
1227	Fresno	1890	28.40	28.62	.34	.59					
1290	Cupertino	1890	25.00		.55						
2109	Cupertino	1893	30.90		.65			.307			
1298	Mission San José	1890	26.30		.53	.39	13.27			.32	2.45
1685	Mission San José	1892	24.10		.64						
2075	Mission San José	1893	29.10		.47		14.20	.173	.54	.40	3.10
1446	Tulare	1891	26.90		.46						
1795	Tulare	1893	22.80	21.38	.68	.60	10.58		.56		3.80
2150	Tulare	1894	28.40		.45						
1557	Paso Robles	1891	22.15		.82						
1652	Paso Robles	1892	19.25		1.71						

SUMMARY OF ANALYSES OF MUSTS AND WINES OF SOUTHERN FRENCH TYPE—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric.		Body
									At Pressing	At 6 to 8 Months	
	Chauché noir—Continued.										
1868	Paso Robles	1893	21.95	20.99	.92		10.42	.112	.45	.56	3.10
1832	Amador station	1893	25.00		.68			.362	.67		
	Average, Cupertino		**27.95**		**.60**			**.307**			
	Average, Mission San Jose		**26.50**		**.55**	**.39**	**13.63**	**.173**	**.54**	**.36**	**2.78**
	Average, Tulare		**26.03**	**21.38**	**.53**	**.60**	**10.58**		**.56**		**3.80**
	Average, Paso Robles		**21.12**	**20.99**	**1.15**		**10.42**	**.112**	**.45**	**.56**	**3.10**
	Dolcetto.										
1348	Cupertino	1890	19.50		.80						
2111	Cupertino	1893	26.90		.58			.259			
1572	Asti, Sonoma County	1891	27.45	27.65	.31	.30					
	Average, Cupertino		**23.20**		**.69**			**.259**			
	Carignane.										
1251	Fresno	1890	20.60	19.89	.74	.41	11.09	.125	.56	.48	2.36
1335	Cupertino	1890	21.50		.72						
1409	Mission San José	1890	24.80		.95	.33	12.64	.213	.65	.66	3.08
1409	Mission San José (closed vat)	1890	24.80		.95	.27	13.09	.199		.54	2.82
1409	Mission San José (calc. sulph.)	1890	24.80		.95	.45	12.91	.213		.62	3.94
1409	Mission San José (calc. phosph.)	1890	24.80		.95	.40	12.18	.180		.56	3.22
1409	Mission San José (amm. phosph.)	1890	24.80		.95	.39	12.36	.217		.48	3.82
1791	Mission San José	1892	20.60		.99						
2295	Mission San José	1894	20.20		.88						
1447	Tulare	1891	21.70		.44						
1628	Tulare	1892	21.50	18.89	.59	.38	10.42	.143	.54	.56	3.30
1887	Tulare	1893	20.60	18.90	.71	.26	9.90	.070	.56	.53	2.60
2210	Tulare	1894	22.20	21.22	.47		10.42	.146	.53	.44	2.60
1525	Asti, Sonoma County	1891	24.40	23.61	.48	.33	12.54	.240	.57	.48	2.78

1576	Paso Robles	1891	19.70	17.44	.67	.35	9.00	.123	.63	.48	2.60
1742	Paso Robles	1892	24.80	----	.35	----	----	----	----	----	----
2081	Paso Robles	1893	25.90	24.12	.51	.34	12.18	.154	.47	.48	3.30
1871	Amador station	1893	23.30	20.61	.90	.22	----	.400	----	----	----
2173	Amador station	1894	22.60	----	.68	----	----	----	----	----	----
2223	Amador station	1894	25.40	----	.53	----	----	----	----	----	----
	Average, Mission San Jose	----	**21.89**	----	**.94**	**.33**	**12.64**	**.213**	**.65**	**.66**	**3.08**
	Average, Tulare	----	**21.50**	**19.67**	**.55**	**.31**	**10.25**	**.120**	**.54**	**.51**	**2.83**
	Average, Paso Robles	----	**26.47**	**20.78**	**.51**	**.35**	**10.59**	**.139**	**.55**	**.48**	**3.45**
	Average, Amador station	----	**23.77**	**20.61**	**.70**	**.22**	----	**.400**	----	----	----
	Mataro.										
1252	Fresno	1890	21.30	20.24	.53	.42	10.58	.104	.50	.43	2.32
1255	Amador station	1890	22.40	----	.41	.40	11.45	.156	.63	.50	2.58
2172	Amador station	1894	26.00	----	.33	----	----	----	----	----	----
1574	Asti, Sonoma County	1891	23.05	22.67	.56	.36	12.09	.129	.55	.44	2.35
1596	Asti, Sonoma County	1891	25.00	23.04	.50	.31	13.27	.236	.93	.82	3.35
1609	Mountain View	1891	20.70	20.24	.78	.32	10.75	.143	.78	.52	2.55
1611	Mountain View	1891	21.50	20.99	.70	----	11.45	.255	.71	.39	2.55
1610	San José; Dr. Dudley	1891	22.08	21.80	.77	.40	11.45	.162	.74	.55	2.45
1727	Paso Robles	1892	21.95	----	.47	----	----	----	----	----	----
1921	Paso Robles	1893	22.60	20.99	.60	.23	10.17	.070	.58	.42	2.30
2313	Tulare	1894	23.00	----	.28	----	----	----	----	----	----
	Average, Amador station	----	**24.20**	----	**.37**	**.40**	**11.45**	**.156**	**.63**	**.50**	**2.58**
	Average, Asti, Sonoma County	----	**24.03**	**22.86**	**.53**	**.34**	**12.68**	**.183**	**.74**	**.63**	**2.35**
	Average, Mountain View	----	**21.10**	**20.62**	**.74**	**.32**	**11.10**	**.199**	**.75**	**.46**	**2.55**
	Average, Paso Robles	----	**22.80**	**20.99**	**.44**	**.23**	**10.17**	**.070**	**.58**	**.42**	**2.30**
	Mourastel.										
1326	Cupertino	1890	18.40	----	1.37	.31	9.45	.099	.81	.62	2.32
2045	Cupertino	1893	24.35	----	.86	----	----	.234	.93	----	----
1330	Mission San José	1890	21.50	----	.99	.24	10.75	.191	.78	.52	2.75
1569	Mission San José	1891	21.70	----	.90	----	10.91	.152	.88	.52	2.75
2074	Mission San José	1893	22.10	20.99	.83	.23	10.58	.163	.78	.53	2.30
2343	Mission San José	1894	20.40	----	.57	----	----	.133	.58	----	----
1439	Tulare	1891	19.70	----	.64	----	----	----	----	----	----
1690	Tulare	1892	21.50	21.38	.41	.33	10.67	.143	.48	.50	2.80
1898	Tulare	1893	22.00	20.99	.71	.33	10.17	.087	.69	.47	2.45
2278	Tulare	1894	22.60	21.38	.50	----	----	.139	.55	.45	2.60
1471	Fresno	1891	20.85	19.89	.80	.65	10.17	.168	.63	.53	2.70
1528	Paso Robles	1891	20.60	20.24	.62	.34	----	----	----	----	----
1759	Paso Robles	1892	23.70	----	.46	----	----	----	----	----	----
2071	Paso Robles	1893	24.25	23.91	.50	.33	11.91	.166	.63	.45	2.80
1863	Amador station	1893	21.10	----	1.03	----	----	----	----	----	----
2176	Amador station	1894	24.40	----	.49	----	----	----	----	----	----

Summary of Analyses of Musts and Wines of Southern French Type—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At 6 to 8 Months	Body
	Mourastel—Continued.										
	Average, Cupertino		**21.38**		**1.11**	**.31**	**9.45**	**.167**	**.87**	**.62**	**2.32**
	Average, Mission San Jose		**21.42**	**20.99**	**.82**	**.24**	**10.74**	**.159**	**.73**	**.52**	**2.60**
	Average, Tulare		**21.45**	**21.35**	**.56**	**.33**	**10.42**	**.123**	**.57**	**.47**	**2.62**
	Average, Paso Robles		**22.85**	**22.08**	**.53**	**.34**	**11.91**	**.166**	**.63**	**.45**	**2.80**
	Average, Amador station		**22.75**		**.76**				**.76**		
	Beclan.										
1927	Paso Robles	1893	23.25	22.04	.50	.25		.259	.47		
2273	Mission San José	1894	23.70	22.90	.45						
1967	Tulare	1893	24.80	23.42	.23	.36	11.48	.138	.42		
2314	Tulare	1894	24.50		.33						
	Average, Tulare		**24.65**	**23.42**	**.28**	**.36**	**11.48**	**.138**	**.42**		
	Petit Bouschet.										
1245	Fresno	1890	24.70	25.76	.51	.41					
1378	Mission San José	1890	23.50		.80	.39	11.36	.485	.83	.37	3.32
1778	Mission San José	1892	21.60	21.80	.92						
2226	Mission San José	1894	19.70	19.21	.73		8.07	.266	.77	.62	3.30
2293	Mission San José	1894	21.50		.58		9.54	.345		.49	3.50
1394	Cupertino	1890	23.70		.69						
2048	Cupertino	1893	20.40		.80			.473			
2120	Cupertino	1893	18.60		.84			.502			
1435	Tulare	1891	22.20	22.05	.53	.50	11.00	.227	.43	.45	3.12
1627	Tulare	1892	22.20	21.38	.57	.45	11.09	.185	.58	.50	3.05
1882	Tulare	1893	21.20	19.54	.65	.32	10.03	.221	.48	.52	2.85
2168	Tulare	1894	22.30	21.80	.43		10.58	.298	.55	.35	2.85
1529	Paso Robles	1891	20.05		.51	.45					
1745	Paso Robles	1892	20.40		.51						

2009	Paso Robles	1893	24.80	24.12	.47	.29	11.91	.480	.48	.47	3.10
	Average, Mission San Jose	------	**21.57**	**20.50**	**.76**	**.39**	**9.66**	**.365**	**.80**	**.49**	**4.37**
	Average, Cupertino	------	**20.90**	------	**.78**	------	------	**.488**	------	------	------
	Average, Tulare	------	**21.97**	**21.19**	**.54**	**.42**	**10.67**	**.232**	**.51**	**.45**	**2.97**
	Average, Paso Robles	------	**21.75**	**24.12**	**.49**	**.37**	**11.91**	**.480**	**.48**	**.47**	**3.10**
	Alicante Bouschet.										
1241	Fresno	1890	22.15	20.61	.71	.42	11.27	.214	------	.53	2.82
1396	Cupertino	1890	25.90	------	1.02	------	------	------	------	------	------
2046	Cupertino	1893	23.70	------	1.25	------	------	.604	1.31	------	------
2112	Cupertino	1893	23.10	------	1.03	------	------	.474	.83	------	------
1581	Mission San José	1891	24.35	22.67	.77	.43	11.91	.398	.72	.50	3.05
1790	Mission San José	1892	23.70	------	.81	------	------	------	------	------	------
	Average, Cupertino	------	**24.23**	------	**1.10**	------	------	**.539**	**1.07**	------	------
	Average, Mission San Jose	------	**24.00**	**22.67**	**.79**	**.43**	**11.91**	**.398**	**.72**	**.50**	**3.05**

NORTH ITALIAN TYPE—RED.

(See Vit. Rept. 1887–89, p. 117.)

The judgment expressed in the last report regarding the grapes of the North Italian type has been but slightly modified by later experiments. Some of the finer varieties, such as the Nebbiolo and Bonarda, while making excellent wines of their class, have not borne sufficiently to be recommended for any of the localities yet tried. Certain others, such as the Dolcetto, while bearing well, have not shown sufficient quality to encourage their dissemination. The Marzemino is worthy of further study. The varieties which have given the best results are the Refosco ("Crabb's Burgundy"), Barbera, and Fresa. The first of these shows the widest adaptability, producing well and giving good wine, both in the coast counties and in the interior valleys. It is especially promising for the San Joaquin Valley, where, together with the Barbera and the Tinta Valdepeñas, very good results have been obtained in the production of dry, red wines. The Barbera has not succeeded well in the coast counties, and, except perhaps in some extra hot location, is not to be recommended for that region. The Fresa has done well at Cupertino and at Paso Robles, and would doubtless be successful in other parts of the lower coast counties. It has, however, a very marked flavor, somewhat resembling that of Zinfandel, which many people would not find agreeable and it would therefore be inadvisable to plant it too freely.

The especial advantage possessed by the North Italian type of grapes is that they supply a large proportion of acid together with high sugar content, and that they resist exposure on the vines remarkably well and supply bunches sound throughout. They are therefore desirable for wine-making in hot climates, not only by themselves, but especially for blending with other varieties whose acid content falls so low under the influence of heat as to jeopardize sound fermentation and produce flavorless wines.

NEBBIOLO.

(See Vit. Rept. 1885–86, p. 87; 1887–89, p. 127.)

A full description of this variety is given in the places cited, and later results have confirmed the opinions expressed there. The vine is healthy, but a small grower, and with its small leaves is apt to allow the grapes to sunburn. The wine is of excellent quality, but lacking in color, and not sufficiently superior to other of the Italian varieties to make up for its deficiency in bearing. In all the localities tried the must is characterized, like that of most of the North Italian varieties, by its high acidity and high sugar. At Tulare and at Paso Robles stations, however, the acidity is lower than in the case of Barbera. The color is irregular, like that of the Aramon. Occasionally in the Bay region it will be sufficient and of fairly good tint, but generally it is very light and yellowish.

ANALYSES OF MUSTS AND WINES.

NEBBIOLO (FINO, BOURGU, ETC.).	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
						By Weight	By Volume		At Pressing	At 6 to 8 Months	
1890—No. 1285. Cupertino	Oct. 1	22.80	------	.82	.22	------	------	------	------	------	------
No. 1364. Cupertino	Oct. 14	23.70	------	.96	------	------	------	------	------	------	------
1891—No. 1575. Asti, Sonoma County	Oct. 8	*26.90	27.65	.45	.26	11.08	13.54	.281	.69	.50	3.20
1892—No. 1695 (Fino). Tulare	Sept. 27	22.80	------	.80	------	------	------	------	------	------	------
No. 1700 (Bourgu). Tulare	Sept. 27	25.40	------	.41	------	------	------	------	------	------	------
1893—No. 1857 (Fino). Amador station	Sept. 14	20.60	------	1.15	------	------	------	------	------	------	------
No. 1858 (Bourgu). Amador station	Sept. 14	20.20	------	1.07	------	------	------	------	------	------	------
No. 1938 (Bourgu). Paso Robles	Oct. 12	25.90	24.97	.53	.34	------	------	.281	------	------	------
No. 2039 (Bourgu). Cupertino	Oct. 30	23.70	------	1.26	------	------	------	.387	------	------	------
No. 2058 (Fino). Cupertino	Oct. 30	23.30	------	1.14	------	------	------	.352	------	------	------
1894—No. 2277. Asti, Sonoma County	Oct. 6	22.20	21.38	.99	.31	------	------	------	------	------	------

* Added water and tartaric acid before fermentation.

RECORD OF TREATMENT.

No. 1285. *Nebbiolo*, from Cupertino. A sample for must analysis was received October 3, 1890, in good condition, but not quite ripe. The must showed 22.8% of solid contents by spindle and 0.82% of acid.

No. 1364. *Nebbiolo bourgu*, from Cupertino. A sample for must analysis was received October 17, 1890, in good condition, and mature. The must showed 23.7% of solid contents by spindle and 0.96% of acid.

No. 1575. *Barolo*, from Asti, Sonoma County. Received October 10, 1891, in good condition, and mature, a few of the grapes beginning to dry. The grapes were apparently identical with the Nebbiolo fino. The must showed 26.9% of solid contents by spindle and 0.45% of acid. The temperature of the grapes at crushing was 63°. One hundred and four pounds were crushed and put to ferment with an addition of 68 grs. of tartaric acid and ¾ gal. of water. The maximum temperature reached was 85°, on the fourth day. The must fermented slowly, but was dry on the seventh day, when it was drawn off.

At one month the wine was clear, of full and agreeable flavor and aroma, and high astringency. At two months it was racked, and at four months the lees were examined and found to be perfectly sound. At five months the wine was bright, with some bouquet and full flavor, high body and astringency, rough, but very promising. An examination of the lees showed them to be perfectly sound. Three months later the wine was in good condition, a heavy-bodied, alcoholic wine, but toned down considerably since last tasting. At fifteen months it was excellent in every respect except in color, which was very light. At sixteen months it was bottled, on account of the smallness of the keg. Two years after bottling the wine was bright, with some bouquet and good flavor, clean taste, and high astringency, much superior to the wine of Mataro of the same year and locality.

No. 1695. *Nebbiolo fino*, from Tulare station. A sample for must analysis was received September 29, 1892, in good condition. The must showed 22.8% of solid contents by spindle and 0.80% of acid.

No. 1700. *Nebbiolo bourgu*, from Tulare station. A sample for must analysis was received September 29, 1892, in good condition. The must showed 25.4% of solid contents by spindle and 0.41% of acid.

No. 1857. *Nebbiolo fino*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition, but not mature. The must showed 20.6% of solid contents by spindle and 1.15% of acid. The bunches were small, compact, cylindrical; the berries small.

No. 1858. *Nebbiolo bourgu*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition. This sample seems to be identical with No. 1857. The must showed 20.2% of solid contents by spindle and 1.07% of acid.

No. 1938. *Nebbiolo bourgu*, from Paso Robles station. A sample for must analysis was received October 13, 1893, in good condition, sweet and mature. The bunches were of good size, conico-cylindrical, close; the berries round, reddish, and very juicy. The must showed 25.9% of solid contents by spindle and 0.53% of acid. The vines were grown in sandy soil, pruned long, and bore at the rate of about one ton per acre.

No. 2039. *Nebbiolo bourgu*, from Cupertino. A sample for must analysis was received October 31, 1893, in good condition, and mature. The bunches were under medium size, cylindrical, with small wings, well filled; the berries small, very acid. The must showed 23.7% of solid contents by spindle and 1.26% of acid.

No. 2058. *Nebbiolo fino*, from Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were of medium size, long cylindrical, with a small wing, close; the berries of medium size, round, well colored, crisp, juicy, with good acid, and mature. The must showed 23.3% of solid contents by spindle and 1.14% of acid.

BARBERA.

(See Vit. Rept. 1883–85, p. 111; 1885–87, p. 85; 1887–89, p. 134.)

The last experiments with the Barbera have been principally with grapes from the Tulare station, to which locality it seems particularly well suited. The vines of this variety are there planted in sandy soil where the alkali is not very strong, and they make a strong and healthy growth. They produce about five tons per acre of fine, clean grapes. The grapes are thick-skinned, not too close, and very resistant to injuries from any source. They are firm, juicy, fresh-tasting, and ripen well without losing their acid. The average composition of the must for four years has been 24% of solid contents, and 0.76% of acid—an excellent ratio between sugar and acid, insuring good fermentation. This is a lower ratio of acid to sugar than is given by the same grape in cooler localities, but is well up to the average, and better than is given by any other grape yet tried at Tulare. In tannin it falls much below the amount obtained from it in other localities, an average of 0.173% compared to 0.274% at Cupertino.

The first wine made from this variety at Tulare, while the vines were young, was lacking in color, but was of good quality and marked character. The wines made after the first year were of good color, acid, and body, but still rather low in tannin. A blend with a grape like Gros Mansenc, St. Macaire, or, best of all, Refosco, is needed to increase the tannin, and improve the keeping qualities. No. 1573 is a good example of the heavy Italian type of wines, with high alcohol and full acid, astringency, and body. This wine, notwithstanding the smallness of the quantity made, was not fully aged at three years and a half.

The Barbera, then, seems to be very well suited to the warmer localities of the State, but requires blending to make a good commercial wine. When grown on warm, hillside soils, such as those of the Asti Vineyard in the upper Russian River Valley, it should be blended with some lighter grape to decrease its roughness and hasten its maturity; but in the rich valley soils, such as those of Tulare, it needs the addition of some robust grape to improve its keeping qualities.

This variety has received a very thorough test at Cupertino, and more especially on Prof. Hilgard's vineyard at Mission San José. At the latter place, as was pointed out in the last report, its chief fault has been irregularity of bearing. Prof. Hilgard has found that its bearing qualities are much better when grafted on Californica stock than when on Riparia.

ANALYSES OF MUSTS AND WINES.

BARBERA.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—No. 1324.	Cupertino	Oct. 11	27 65	------	.50	------	------	------	------	------	------	------
1891—No. 1445.	Tulare	Aug. 26	25.65	------	.77	------	------	------	------	------	------	------
No. 1573.	Asti, Sonoma County	Oct. 9	28.80	28.52	.75	.40	11.62	14.20	.265	.85	.52	3.25
1892—No. 1675.	Tulare	Sept. 18	24.55	25.76	.65	.71	9.78	12.18	.124	------	.56	3.20
1893—No. 1931.	Tulare	Oct. 12	23.50	21.22	1.03	.41	9.56	11.91	.192	.89	.58	3.40
No. 2040.	Cupertino	Oct. 30	25.90	------	1.32	------	------	------	.441	------	------	------
1894—No. 2211.	Tulare	Sept. 28	24.80	23.61	.60	------	10.07	12.50	.204	.65	.52	3.11
No. 2276.	Asti, Sonoma County	Oct. 6	25.30	24.12	.79	------	------	------	------	------	------	------

COLOR READINGS.

BARBERA.		At Pressing.	One Month.	Two Months.	Three Months.	Four Months.	Five Months.
1891—No. 1573.	Asti, Sonoma County	72.7 2VR	72.7 2VR	50.6 2VR	31.3 3VR	27.0 5VR	------
1892—No. 1675.	Tulare	Color too light for the scale.					
1893—No. 1931.	Tulare	90.9 1VR	32.5 1VR	32.0 2VR	25.9 3VR	22.0 4VR	20.1 5VR
No. 2040.	Cupertino	129.0 1-2VR	------	------	------	------	------
1894—No. 2211.	Tulare	46.0 2VR	34.7 1VR	20.5 5VR	18.4 5VR	------	------

Record of Treatment.

No. 1324. *Barbera*, from Cupertino. A sample for must analysis was received October 13, 1890, in poor condition, quite mature. The must showed 27.65% of solid contents by spindle and 0.50% of acid.

No. 1445. *Barbera*, from Tulare station. A sample for must analysis was received August 29, 1891, in good condition. The must showed 25.65% of solid contents by spindle and 0.77% of acid.

No. 1573. *Barbera*, from Asti, Sonoma County. Received October 10, 1891, in fair condition, quite mature. The must showed 28.8% of solid contents by spindle and 0.75% of acid. The 171 lbs. were crushed on the day of arrival, at a temperature of 62°. The maximum reached was 94°, on the fourth day. The wine was nearly dry on the sixth day and was drawn off on the seventh.

At five weeks the wine was clear, well flavored, and full-bodied; it was very fruity and had a trace of sugar. A month later it was bright and sound; it was racked, and the lees showed no unsoundness. At four months the lees showed a few filaments, but the wine was quite bright, dry, and very good but for a slightly bitter after-taste. At five months it was bright, extremely smooth, and fruity, with rather less tannin than is usual for Barbera, but quite sufficient. It was racked for the third time at ten months, and the lees seemed sound. At sixteen months the wine showed very high quality, but a slightly bitter after-taste. Two months later it was racked and part put in bottle. At twenty-two months it had retained its high quality, and the rest of it was bottled. At three years and a half the bottled wine was bright, not deeply colored, with good bouquet and flavor, clean taste, developing well, but still a little too rough.

No. 1675. *Barbera*, from Tulare station. Received September 21, 1892, in good condition, and mature. The must showed 24.53% of solid contents by spindle and 0.65% of acid. The 114 lbs. were crushed at a temperature of 68°. The maximum reached was 77°, on the third day, when it was racked off.

At one month the wine was clear and clean-tasting, but almost without color. At four months it was bright, agreeable, fruity, almost sweetish, but quite sound. The lees were examined and found to be sound, and the wine was racked for the second time at six months. At nine months it was dry and in good order. At eleven months it was a fair wine. with a marked but not very delicate bouquet. Four months later it had lost nearly all its color, but had kept fairly well. At seventeen months it was bottled.

No. 1931. *Barbera*, from Tulare station. Received October 13, 1893, in good condition. The bunches were of medium size, close, cylindrical; the berries large to medium, oval, firm, but juicy, thick-skinned, mature, with fresh taste and pleasing acid. The weight of grapes crushed was 178 lbs., and the must showed 23.5% of solid contents by spindle and 1.03% of acid. The temperature of the grapes at crushing was 67°, and the maximum reached was 91°, on the third day. The wine was dry on the fifth day, and was pressed on the sixth.

At the end of one month the wine was not quite clear, and still a little sweet. A week later it was racked and taken to the cellar; and at four months it was bright, with some bouquet and flavor, full acid and clean taste. Two months later it had improved, but was still very rough. At ten months the wine was good, but a little flat. An examination of the lees showed the presence of a few filaments. The wine was racked for the third time, and part of it put in bottle. At sixteen months it had changed little from the last tasting; it was a full-bodied, well-colored wine, but not quite clean-tasting. A month later it was racked again and part put in bottle.

No. 2040. *Barbera*, from Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were of medium size, conical, loose, and coulured; the berries of over medium size when not abortive, ripe, but with very high acid. The must showed 25.9% of solid contents by spindle and 1.32% of acid.

BONARDA.

(See Vit. Rept. 1887–89, p. 144.)

For the description of this variety see the above reference. Three distinct varieties have been received and planted at the stations under this name. Like many Italian names, Bonarda is used to designate several varieties of grapes in different localities of Italy. This makes the correct determination of Italian varieties very difficult. One of the varieties which we have received under this name, however, seems to be the true Bonarda of Piedmont and is the one here referred to. It is very similar in character to other North Italian grapes we have tried. It gives excellent color and is characterized by high acid and the roughness of its wine when new. So far, it has not borne very well, but the character of its grapes and wine makes it desirable to experiment with in other localities.

Another variety received under this name is more promising as a table-grape than as a wine-grape. It is a large, round grape, with a full, agreeable flavor, something like that of the true Malvoisies. It seems to be very close to, if not identical with, the Dolcetto as grown at the Swiss-Italian colony of Sonoma County. This latter is one of the most widely grown grapes of northern Italy, where it is highly appreciated on account of its heavy-bearing qualities, and is used both as a table-grape and for the making of common red wines.

ANALYSES OF MUSTS AND WINES.

BONARDA.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—No. 1362. Cupertino	Oct. 14	22.82	------	.72	.22	9.41	11.73	.400	.71	.32	2.70
No. 1384. Cupertino	Oct. 21	25.20	------	1.02	.90	9.92	12.36	.286	------	.60	2.58
No. 1385. Cupertino	Oct. 19	24.45	------	1.09	------	------	------	------	------	------	------
1891—No. 1599. Cupertino	Oct. 23	24.80	------	.91	.33	9.92	12.36	.356	.83	.83	3.35
1893—No. 1869. Paso Robles	Sept. 13	22.80	19.89	.45	.41	8.06	10.08	.134	.41	.57	2.80
No. 2108. Cupertino	Nov. 1	25.00	------	.68	------	------	------	.496	------	------	------
No. 2110 (No. 2). Cupertino	Nov. 1	24.80	------	.78	------	------	------	.253	------	------	------
1894—No. 2310. Tulare	Oct. 13	26.50	------	.39	------	------	------	------	------	------	------

COLOR READINGS.

BONARDA.	At Pressing.		One Month.		Two Months.		Three Months.		Four Months.	
1891—No. 1599. Cupertino	20.9	R	14.7	1R	12.5	3R	13.3	2VR+Y	11.6	3VR+Y
1893—No. 1869. Paso Robles	8.6	3R	9.0	3R	------	------	------	------	------	------
No. 2108. Cupertino	97.5	VR-1VR	------	------	------	------	------	------	------	------
No. 2110. Cupertino	15.4	5VR	------	------	------	------	------	------	------	------

Record of Treatment.

No. 1362 *Bonarda*, from Cupertino. Received October 17, 1890, in good condition, and mature. The must showed 22.82% of solid contents by spindle and 0.72% of acid. There were 126 lbs. crushed, the initial temperature being 64°; the maximum reached was 82°, on the third day. On the fifth day the wine was nearly dry, and was drawn off.

At one month the wine was nearly clear, of deep color, without aroma, with very high astringency and medium acid, still very raw and undeveloped. One month later the lees were examined, found to be in good condition, and the wine was racked. At three months it was bright, with light bouquet and good flavor, remarkably high astringency, good body and vinosity; in general, very rough, but promising. An examination of the lees showed the presence of some short filaments, and though the taste was unaffected, the wine was pasteurized. Three months after pasteurizing it was bright, still very rough, but of excellent flavor and general quality. At seven months it was racked for the third time. At fourteen months it was in good order, of deep color, good flavor and bouquet, and was maturing well. At seventeen months it was racked and part put in bottle; at twenty-three months the rest was bottled. At three years and three months both samples were sound, but not clear, very rough, and had deposited much sediment

No. 1384. *Bonarda No. 2*, from Cupertino. This grape is distinct from the Bonarda numbered 1362, and is apparently the Bonarda di Gattinara or Uva Rara, with the description of which in Pulliat and Rovasenda it agrees. The grapes were received October 23, 1890, and 172 lbs. were crushed. The must showed 25.2% of solid contents by spindle and 1.02% of acid. The temperature of the grapes at crushing was 68°, and the maximum reached was 92°, on the third day. The wine was still a little sweet on the fourth day, when it was racked.

At one month the wine was clear, and showed very high acid and astringency. At two months it was racked, and the lees were sound. At three months the lees showed a few filaments, but the wine was bright, with very good bouquet and flavor, and clean taste; it was, however, pasteurized for safety. At seven months it was bright and showed high quality; it was still rough, but had commenced to mature. At eight months it was racked for the third time. At fifteen months it was in good order, with fair but yellowish color, full rich bouquet and flavor, clean taste, high astringency, and good body. It was nearly mature, and two months later it was racked and part put in bottle; at twenty-five months the remainder was bottled. At three years and three months both bottled samples were bright and in first-class order. That first bottled was of better color and fresher taste than the second, but not so smooth; both were very good wines, but somewhat lacking in color, and rather rough.

No. 1385. *Bonarda No. 1*, from Cupertino. This grape was received under the name of Provinante; it is probably the Pruiné, as it agrees very closely with the description of that variety as given by Rovasenda. The grapes were received October 21, 1890, in good condition, and mature. The must showed 24.45% of solid contents by spindle and 1.09% of acid. Only a sample for must analysis was received.

No. 1599. *Bonarda*, from Cupertino. Received October 24, 1891, in good condition. The must showed 24.8% of solid contents by spindle and 0.91% of acid. There were 47 lbs., which were crushed at a temperature of 66°; the maximum reached was 75°, on the sixth day. On the ninth day the wine was drawn off while still a little sweet.

Three weeks after pressing the wine was clear, dry, with high acid and astringency. At four months the wine was racked for the second time, and the lees were sound. At five months the wine was bright, with full bouquet and flavor, very rough, but of excellent promise. The lees were examined and found to be sound, and two months later the wine had improved, and although still crude was of great solidity and promise. At eight months it was racked for the third time.

No. 1869. *Bonarda*, from Paso Robles station. A small sample was received September 15, 1893, in good condition. The bunches were over medium in size, conico-cylindrical, very compact; the berries were of medium size, well colored, and very sweet. The must showed 22.8% of solid contents by spindle and 0.45% of acid. The grapes were fermented for color and tannin tests.

No. 2108. *Bonarda*, from Cupertino. A sample for must analysis was received November 1, 1893, in good condition. The bunches were over medium in size, long cylindrical, winged, and well filled; the berries were of medium size, round, thick-skinned, and very sweet. The must showed 25.0% of solid contents by spindle and 0.68% of acid.

No. 2110. *Bonarda No. 2* (Uva Rara), from Cupertino. A sample for must analysis was received November 1, 1893, in good condition. The bunches were large, conical, heavily shouldered, compact; the berries were over medium in size, pulpy, very sweet, but with high acid. This variety bears great resemblance to No. 2111, Dolcetto, but the berries are not so hard and have less of the distinctive flavor. (Nos. 2110 and 2111 are probably identical. Prof. Hilgard.)

FRESA.

(See Vit. Rept. 1887–89, p. 149.)

The best results with this variety so far have been obtained at the Cupertino and the Paso Robles stations. At the former the average composition of the must has been 24.8% of sugar and 0.77% of acid—a lower percentage of acid than has been obtained with most of the other Italian varieties. At Paso Robles station the ratio of acid to sugar has been still lower, but quite sufficient; at Tulare, the acid percentage has been rather low, and as the vines have borne poorly they seem unsuited to that locality. From all localities the wine has heavy body and high astringency. It has a very marked and peculiar flavor, coarse but not unpleasant, something of the same nature as the special flavor of the Zinfandel, rendering it unsuitable for blends where a neutral wine is desired. Like the other Italian wines it is at first very rough, and even slower to mature than the others, and even with aging it does not attain the delicacy of the Nebbiolo or the Barbera. The color of the wine is somewhat yellowish, and, except at Cupertino, is insufficient in intensity. Of the localities tested, the Fresa seems to be best suited to Paso Robles, where, with the help of some color grape, it could be used for the production of a common wine of rather better character and keeping qualities than that of the Zinfandel.

ANALYSES OF MUSTS AND WINES.

FREISA DI MONFERRATO, OR FRESA.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—No. 1327.	Cupertino	Oct. 11	23.90	------	94	.21	9.78	12.18	.451	.97	.53	3.08
1891—No. 1469.	Fresno	Aug. 29	28.20	28.33	.50	.50	11.46	14.00	------	.80	.50	3.82
No. 1553.	Paso Robles	Oct. 6	25.90	------	.43	------	------	------	------	------	------	------
No. 1600.	Cupertino	Oct. 20	25.20	24.64	.77	.45	9.99	12.46	.440	------	.70	3.05
1892—No. 1643.	Paso Robles	Sept. 13	24.14	------	.76	------	------	------	------	------	------	------
No. 1703.	Tulare	Sept. 27	24.35	------	.41	------	------	------	------	------	------	------
1893—No. 1830.	Amador station	Sept. 7	20.40	------	.89	.22	------	------	.461	------	------	------
No. 1913.	Paso Robles	Oct. 4	24.80	23.61	.66	.68	9.63	12.00	.285	.70	.43	2.80
No. 1976.	Tulare	Oct. 4	27.35	------	.38	.31	------	------	------	------	------	------
No. 2130.	Cupertino	Nov. 1	25.20	------	.88	------	------	------	.265	------	------	------
1894—No. 2175.	Amador station	Sept. 24	23.70	------	.68	------	------	------	------	------	------	------
No. 2318.	Tulare	Oct. 15	24.80	------	.41	------	------	------	------	------	------	------

COLOR READINGS.

FRESA.		At Pressing.	One Month.	Two Months.	Three Months.	Four Months.	Five Months.
1890—No. 1327.	Cupertino	------	------		------	------	------
1891—No. 1469.	Fresno	24.0 4VR+Y	17.4 4VR+Y	11.9 1R+Y	11.1 1R+Y	10.4 1R+Y	10.4 3R+Y
No. 1600.	Cupertino	78.4 5VR	37.0 R	37.0 R-1R	30.5 1R	------	------
1893—No. 1830.	Amador station	33.9 R	33.1 3VR	------	------	------	------
No. 1913.	Paso Robles	23.6 4VR	33.3 3VR	19.5 R	18.3 R	17.5 1R	10.6 3R
No. 2130.	Cupertino	42.1 5VR	------	------	------	------	------

Record of Treatment.

No. 1327. *Fresa*, from Cupertino. Received October 13, 1890, in good condition. The must showed 23.9% of solid contents by spindle and 0.94% of acid. There were 191.5 lbs. crushed. The temperature at crushing was 65°, and the maximum reached was 92°, on the fourth day. On the fifth day the wine was still a little sweet, and was drawn off on the sixth.

At three weeks the wine was clear and showed very high acid and astringency. At two months, when the wine was racked for the second time, the lees were sound. At three months the lees showed a few short filaments, and the wine was pasteurized. When pasteurized it was bright, with good, deep color, marked but not delicate aroma and flavor, high astringency, full acid, good body and alcohol. It was a good, solid wine, but a little rough and coarse. Two months after pasteurizing it was bright and developing, but rough, heavy, and extremely astringent. At fifteen months it was in good order, of deep garnet color, with some bouquet, good flavor, and clean taste. It was much smoother and nearly mature. At seventeen months it was racked for the fifth time, and part bottled; at twenty-three months the rest was bottled. At three years and three months both samples were in excellent condition, of good color and body, well flavored, and with little bouquet; the second bottling was smoother than the first, and generally more pleasing.

No. 1469. *Fresa*, from Fresno. Received August 31, 1891, in fair condition, a little dried. The must showed 28.2% of solid contents by spindle and 0.50% of acid. There were 44.75 lbs. crushed. The temperature at crushing was 70°, and the maximum reached was 81°, on the fourth day. The wine was drawn off on the seventh day while still a little sweet.

At two weeks the wine was cloudy and still slightly sweet, but at one month it was clear and almost dry. At six weeks it was bright, with good color, full flavor and aroma, clean taste, and high astringency—a very promising wine. At three months it was racked for the second time, and an examination of the lees showed them to be sound. At this time it was clear, sound, and good, but still had a trace of sweetness. At five months it was still very rough, but clean-tasting and fruity. The lees were sound, and at seven months the wine was smoother and much improved; it was a rich, fruity wine, and had kept remarkably well for such a small sample (two gallons). The sample being so small, it was bottled at this date. At three years and a half the bottled wine was clear, but had made a heavy deposit; it was a very good, clean-tasting wine, with some flavor and bouquet, altogether one of the best table-wines made from Fresa, but was bottled too soon.

No. 1553. *Fresa*, from Paso Robles station. Received October 8, 1891, in good condition. The bunches were small, the berries of medium size and mature. The must showed 25.9% of solid contents by spindle and 0.43% of acid. Only a sample was received for must analysis.

No. 1600. *Fresa*, from Cupertino. Received October 21, 1891, in fair condition, with many small berries and also half-dried ones. The must showed 25.2% of solid contents by spindle and 0.77% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 81°, on the third day. The wine was dry on the fifth day, when it was drawn off.

In one month the wine was clear and of good quality, except that the odor was not good. At four months it was bright, well defecated, of good quality, but very astringent; the lees were sound and the wine was racked for the second time. It remained bright and sound, but was still very rough when racked for the third time at ten months. At fifteen months it was in good order, with somewhat coarse but not disagreeable odor, and the special flavor of the Fresa very pronounced. It was still very rough and not mature, but was bottled, as the quantity was too small to keep longer. At three years and four months the bottled wine was bright—an extremely rich, full wine, but rather coarse and too heavy and solid to be used alone. It had evidently been bottled before it was mature.

No. 1643. *Fresa*, from Paso Robles station. A sample for must analysis was received September 16, 1892, in good condition. The must showed 24.14% of solid contents by spindle and 0.76% of acid.

No. 1703. *Fresa*, from Tulare station. A sample for must analysis was received September 29, 1892, in fair condition. The must showed 24.34% of solid contents by spindle and 0.41% of acid.

No. 1830. *Fresa*, from Amador station. A sample for must analysis was received September 8, 1893, in good condition, but not quite mature. The bunches were small, rounded, and well filled; the berries were small and of reddish color. The must showed 20.4% of solid contents by spindle and 0.89% of acid.

No. 1913. *Fresa*, from Paso Robles station. Received October 6, 1893, in good condition. The bunches and berries were small, but with good characteristic flavor. The must showed 24.8% of solid contents by spindle and 0.66% of acid. The grapes came from long-pruned vines growing on sandy soil, and were produced at the rate of about three tons per acre. There were 207 lbs. crushed. The temperature of the must at crushing was 63°, and the maximum, reached the fourth day, was 91°. The wine was not quite dry when it was drawn off on the sixth day.

In three weeks the wine was nearly clear, but very rough. At six weeks it was clear, of good flavor, and with a slight sweetness. At four months it was bright, quite dry, with some bouquet, good flavor, medium acid, high astringency—a very promising wine. At this time it was racked for the second time. Three months later it was still very rough, but showed excellent keeping qualities. At sixteen months it was in good order, with marked and characteristic aroma and flavor—a full, rich wine, but lacking in delicacy. An examination of the lees showed them to be perfectly sound. A month later the wine was racked and part put in bottle.

No. 1976. *Fresa*, from Tulare station. A sample for must analysis was received October 6, 1893, in good condition. The bunches were very small, short, cylindrical, close; the berries were under medium in size, round, astringent, juicy, with very thick, tough skin, overripe, and much shriveled. The must showed 27.45% of solid contents by spindle and 0.38% of acid. The vines from which this sample came were growing in alkali soil, pruned half-long, and bore at the rate of about four tons to the acre.

No. 2130. *Fresa*, from Cupertino. A sample for must analysis was received November 1, 1893, in good condition. The bunches were of medium size, conico-cylindrical, compact, with small shoulders; the berries were crisp, pulpy, with thick but tender skin, high acid, but mature. The must showed 25.2% of solid contents by spindle and 0.88% of acid.

MORETTO.

Synonyms: Croetto; Lambrusca.

Description.—Vigorous and productive, with strong, somewhat erect canes; leaves large, somewhat downy below, of irregular shape, with or without sinuses, teeth short, veins reddish; bunches small to over-medium, close, short cylindrical, occasionally winged; berries over the average in size, round, thick-skinned, firm, juicy, with neutral flavor.

This variety is extensively cultivated on the plains of Alexandria, in northwestern Italy. It is valued on account of its fertility and its resistance to spring frosts. It is a good, healthy vine, accommodating itself to almost any soil or exposure. Its wine is not considered of high quality. Contrary to the results in Italy, the Moretto, as grown at the stations, has shown itself a poor bearer. The wine has always been unsatisfactory and of very poor keeping qualities. It is, therefore, a variety which cannot at present be recommended for any locality. There are several variations of this variety which are at present being tested; it is, therefore, possible that one of these may prove as satisfactory as they have done in Italy.

Analyses of Musts and Wines.

MORETTO.		Date of Picking	MUST.				WINE.
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Tannin
1892—No. 1633.	Tulare	Sept. 4	24.01	......	.62	......	....
1893—No. 1852.	Amador station	Sept. 13	19.70	......	.77	......	.208
No. 1889.	Tulare	Sept. 1	22.40	21.22	.38	.59	.224
No. 1906.	Tulare	Oct. 2	23.25	20.24	.75	.32	....
No. 1926.	Paso Robles	Oct. 12	24.60	23.32	.43	.35	.214
1894—No. 2177.	Amador station	Sept. 24	24.70	......	.56	......	....
No. 2215.	Paso Robles	Sept. 28	22.80	......	.68	......	....
No. 2319.	Tulare	Oct. 15	26.30	......	.53	......	....

Record of Treatment.

No. 1633. *Moretto*, from Tulare station. A sample for must analysis was received September 6, 1892, in good condition. The must showed 24.01% of solid contents by spindle and 0.62% of acid.

No. 1852. *Moretto*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition. The bunches were of medium size, very compact; the berries of medium size, thick-skinned, fleshy, fairly well colored, and with some flavor. The must showed 19.7% of solid contents by spindle and 0.77% of acid.

No. 1889. *Moretto*, from Tulare station. A sample for must analysis was received September 2, 1893, in good condition. The bunches were very small, short-cylindrical, not shouldered, but occasionally with a small wing; the berries of good size, round, close together but not compressed, thick-skinned, firm but juicy, mature, but with little flavor. The must showed 22.4% of solid contents by spindle and 0.38% of acid.

No. 1906. *Moretto*, from Tulare station. Received October 2, 1893, in good condition. The bunches were small and close; the berries of over average size, very sweet. The grapes were very thick-skinned, and some of them were dry. The must showed 23.25% of solid contents by spindle and 0.75% of acid. The temperature of the grapes at crushing was 70°, and the maximum, reached on the third day, was 90°. The wine was nearly dry on the fifth day, when it was pressed.

The wine was rough and sharply acid. It remained cloudy for a long time, and never became clean-tasting. It was racked several times, and finally became bright, but was flat and unpleasing. It did not keep well, and was altogether a very unsatisfactory wine.

No. 1926. *Moretto*, from Paso Robles station. A sample for must analysis was received October 12, 1893, in good condition. The bunches were of good size, compact, and shouldered; the berries of medium size, well colored, very sweet, and commencing to dry up. The must showed 24.6% of solid contents by spindle and 0.43% of acid.

No. 2136. *Croetto*, from Cupertino. A sample for must analysis was received November 7, 1893, in good condition. The bunches were small, close, abruptly conical; berries small, round, crisp and juicy, with thick skin. The grapes were very sweet and some of them were dry. The must showed 24.7% of solid contents by spindie and 0.68% of acid.

FAVORITA.

This variety is cultivated to a limited extent in Piedmont at Rivoli. Judging by the one sample received from Cupertino it possesses in a high degree the characteristics of the North Italian grapes.

Record of Treatment.

No. 2123. *Favorita*, from Cupertino. A sample for must analysis and color test was received November 7, 1893, in good condition. The bunches were of medium size, conical, sometimes elongated, loose, and with wings, on slender peduncles; berries of medium size, round, crisp, with thin but tough skin, on very slender pedicels. The grapes were ripe, but very acid. The must showed 24.8% of solid contents by spindle and 1.04% of acid.

TADONE.

Synonyms: Tadon Nero; Cari; Carola.

Description.—Leaves thick, five-lobed, coarsely toothed, hairy below; bunches large, long conico-cylindrical, well filled, on long, slender peduncles; berries of medium size, round, on slender pedicels, without special flavor. The grapes ripen rather late and the vine requires long-pruning.

The grapes are grown to a limited extent in several parts of Piedmont, where they are used both for wine-making and for the table. They give an alcoholic wine with good color.

RECORD OF TREATMENT.

No. 2106. *Tadone*, from Cupertino. A sample for must analysis was received November 7, 1893, in good condition. The bunches were of medium size, variable in shape (conical, conico-cylindrical, or double), on slender, herbaceous peduncles, well filled but not compact; berries medium to small, round, juicy and rather soft, with thick but tender skin, pedicels slender; flavor not marked, but sweet and with good acid. The must showed 23.1% of solid contents by spindle and 0.94% of acid.

NEIRETTA.

Synonyms: Costiole; Fresa di Nizza.

Description.—Vine vigorous and prolific; leaves large, smooth above, woolly below, very slightly lobed; bunches large, conical, winged, close; berries medium in size, round, thick-skinned, and ripening late.

This variety is cultivated largely in Piedmont, especially in the neighborhood of Saluzzo. It is valued on account of its vigor and heavy bearing. It produces a fair and well-colored wine, but not of high quality or of very good keeping qualities. It does well with short-pruning, especially when the vine is trained on trellis or wires.

RECORD OF TREATMENT.

No. 2135. *Neiretta*, from Cupertino. A sample for must analysis was received November 7, 1893, in good condition. The bunches were of medium size, conical, close, with a small wing; berries medium to small, round, soft, juicy, thick-skinned, mature, and very fresh-tasting. The must showed 22.4% of solid contents by spindle and 0.68% of acid.

REFOSCO.

(See Vit. Rept. 1883–85, p. 93; 1885–86, p. 78; 1887–89, p. 155.)

Synonyms: Raboso; Crabb's Black Burgundy; "Petit Pinot" of some.

The identity of Refosco and Crabb's Black Burgundy may be considered as established; their respective modes of growth and the composition of their respective wines are indistinguishable. They are, therefore, treated here under one head, and the analyses of their wines appear in the same table. The wine, though of the same general character as that of most of the Piedmontese grapes which have been tried in California, is less rough and develops more quickly. The average composition of the must and wine, according to analyses made at the station for a series of years, has shown:

	Solid Contents by Spindle.	Acid.	Tannin.
From Cupertino	24.35%	.50%	.282%
From Mission San José	24.25	.64	.248
From San Joaquin Valley	22.46	.50	.276
From Paso Robles	20 98	.60	.218
From Sonoma	25.90	.45	.257

This shows (except at Paso Robles where the vines are young) good sugar contents and sufficient but not excessive acid; the tannin also is full, but not, as a rule, enough to make the wine excessively rough. The wine has always been full-bodied and with excellent color. It is one of the vines which are most promising for the production of dry red wines in districts resembling the lower San Joaquin Valley. Even at Tulare, where the production of a sufficiently colored wine is exceptionally difficult, it has always given good color and occasionally enough to make it valuable for blending with wines lacking in color.

Analyses of Musts and Wines.

REFOSCO.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
						By Weight	By Volume		At Pressing	At 6 to 8 Months	
1890—No. 1287 (C. B. B.). Cupertino	Oct. 1	23.90	------	.55	.27	------	------	------	------	------	------
No. 1316. Mission San José	Oct. 8	27.55	------	.71	------	------	------	------	------	------	------
No. 1318 (C. B. B.). Cupertino	Oct. 11	25.20	------	.62	.34	10.81	13.27	.244	.66	.42	2.78
No. 1343 (C. B. B.). Mission San José	Oct. 11	26.50	------	.63	.22	10.81	13.27	.264	------	.45	3.32
No. 1390. Cupertino	Oct. 18	24.12	------	.55	------	------	------	------	------	------	------
No. 1416. Cupertino	Oct. 28	29.50	------	1.06	.28	11.77	14.40	.363	1.12	.54	------
1891—No. 1496 (C. B. B.). Paso Robles	Sept. 13	19.30	18.30	.47	.31	7.78	9.73	.170	.46	.30	2.80
No. 1516 (C. B. B.). Mission San José	Oct. 1	24.45	24.53	.74	------	9.70	12.09	.220	.75	.35	3.04
No. 1526 (C. B. B.). Asti, Sonoma County	Oct. 5	25.30	24.12	.39	.33	10.26	12.77	.294	.55	.41	2.95
No. 1584. Mission San José	Oct. 13	24.45	22.67	.50	------	9.63	12.00	.220	.48	.70	3.45
1892—No. 1615 (C. B. B.). Tulare	Aug. 26	21.50	18.58	.48	.30	7.92	9.90	.270	.43	.39	3.05
No. 1650 (C. B. B.). Paso Robles	Sept. 13	21.75	------	.75	------	------	------	------	------	------	------
No. 1707 (C. B. B.). Mission San José	Oct. 4	22.80	22.05	.67	.29	8.98	11.18	.229	.63	.49	2.85
No. 1785. Mission San José	Oct. 19	23.50	------	.57	------	9.05	11.27	.198	.65	.44	2.80
1893—No. 1884 (C. B. B.). Paso Robles	Sept. 19	21.90	19.89	.58	.28	7.92	9.90	.266	.60	.58	2.85
No. 1930 (C. B. B.). Tulare	Oct. 12	22.85	21.47	.41	.49	8.84	11.00	.268	.49	.42	2.60
No. 1949. Mission San José	Oct. 12	23.70	------	.63	------	------	------	.358	------	------	------
No. 2053. Cupertino	Oct. 29	26.50	------	.43	------	------	------	.323	------	------	------
No. 2107 (C. B. B.). Cupertino	Nov. 5	25.90	------	.42	------	------	------	.425	------	------	------
No. 2117. Cupertino	Nov. 5	26.30	------	1.07	------	------	------	.432	------	------	------
1894—No. 2171 (C. B. B.). Tulare	Sept. 24	24.00	23.42	.41	------	9.12	11.36	.291	.40	.51	3.10
No. 2268. Mission San José	Oct. 5	22.40	------	.47	------	------	------	.173	------	------	------
No. 2302. Mission San José	Oct. 12	23.10	------	.43	------	------	------	------	------	------	------

COLOR READINGS.

REFOSCO.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.		Six Months.	
1890—No. 1318.	Cupertino														
No. 1343.*	Mission San José	46.5	1VR												
No. 1416.	Cupertino														
1891—No. 1496.	Paso Robles	46.5	1VR	14.1	4VR	14.1	5VR	13.2	5VR	7.7	3R	8.3	3R		
No. 1516.	Mission San José	166.0	1VR	64.5	1VR	26.5	5VR	23.9	5VR	18.0	R	15.5	1R		
No. 1584.	Mission San José	160.0	VR	44.0	1VR	49.4	2VR	50.0	3VR	34.2	3VR				
1892—No. 1615.	Tulare	21.0	3VR	12.5	4VR	9.8	1R	9.7	3R	8.7	2R	8.3	2R	7.6	2R
No. 1707.	Mission San José	174.0	VR	75.5	1VR	74.2	2VR	62.0	2VR	43.9	2VR	36.7	2-3VR		
No. 1785.†	Mission San José	105.0	VR	71.6	2VR	42.5	4VR	26.0	5VR	24.4	5VR				
1893—No. 1884.	Paso Robles	90.9	VR	54.1	VR	50.6	1VR	34.8	1VR	29.6	1VR	24.4	2VR		
No. 1930.	Tulare	60.6	VR	30.3	1VR	17.2	2VR	17.8	3VR	17.6	3VR	11.6	5VR		
No. 1949.	Mission San José	83.3	VR												
No. 2053.	Cupertino	52.0	2VR												
No. 2107.	Cupertino	74.2	VR-1VR												
No. 2117.	Cupertino	160.0	1-2VR												
1894—No. 2171.	Tulare	42.1	1-2VR	31.7	1VR	31.7	1VR	24.4	3VR						
No. 2268.	Mission San José	46.0	VR												

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* Blend.

† Blend of Refosco and Marzemino.

Record of Treatment.

No. 1287. *Refosco*, from Cupertino. Received October 3, 1890, in bad condition; the bunches showed much coulure. The grapes were ripe, but too few for wine. The must showed 23.9% of solid contents by spindle and 0.55% of acid.

No. 1316. *Refosco*, from Mission San José. Received October 10, 1890, in a much bruised condition. The sample was small and was fermented as a color test. The must showed 27.55% of solid contents and 0.71% of acid.

No. 1318. *Refosco*, from Cupertino. Received October 13, 1890, in rather poor condition. The must showed 25.2% of solid contents by spindle and 0.62% of acid. Two hundred pounds of grapes were crushed, commenced to ferment at a temperature of 65°, and reached a maximum of 92° on the fourth day. The wine was dry on the fifth day, and was pressed on the sixth.

The wine remained turbid and fermented slowly for a month. In two months it was clear, but had a slightly suspicious odor, and was pasteurized at 160°. An examination of the lees showed some filaments. The wine at this time was smooth, of low acid and full astringency, generally of good quality but for slight lactic taint. The wine after this improved, but never quite lost its disagreeable odor, and at fifteen months was bright and of good color, showed good qualities, but also some volatile acid. At seventeen months it was bottled, but did not keep well.

No. 1343. *Refosco*, from Mission San José. Received October 14, 1890, in poor condition, but mature. The must showed 25.2% of solid contents by spindle and 0.63% of acid. The grapes were fermented with No. 1344, an unknown red grape from Mission San José. The temperature of the must at crushing was 65°, and the maximum reached was 96°, on the fourth day. On the fifth day the wine was nearly dry, and was drawn off on the sixth.

At the end of a month the wine was cloudy and still a little sweet. In two months it was clear, smooth, clean-tasting, with some flavor, aroma, and full astringency; it still contained a little sugar. At the first examination the lees were sound, but at four months they showed a few filaments, so the wine was pasteurized. At this date the wine was clear, with a little flavor and bouquet, but a slight moldy taste, and altogether not of high quality. At seven months it had improved, and was smooth, clear, and heavy-bodied. At fifteen months it was clear, of good color, full acid, little flavor, mature, and of fair quality. At seventeen months it was racked for the fourth time and part of it put in glass; the remainder was bottled at twenty-two months, but none of it improved in bottle.

No. 1390. *Refosco*, from Cupertino. A sample for must analysis was received October 21, 1890, in fair condition, somewhat overripe. The must showed 24.12% of solid contents by spindle and 0.55% of acid.

No. 1416. *Refosco*, from Cupertino. Received October 30, 1890, in fair condition. The must showed 29.5% of solid contents by spindle and 1.06% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 82°, on the fourth day. The wine was drawn off on the sixth day, while still very sweet.

The wine soon became quite clear, but remained very sweet. The wine never became dry, but remained clear and sound, and showed no injurious ferments in the lees. At three months the wine was clear, clean-tasting, but with a burnt odor.

No. 1496. *Refosco*, from Paso Robles station. Received September 16, 1891, in good condition. The bunches were rather large and loose, with small grapes, not quite mature. The must showed 19.3% of solid contents by spindle and 0.47% of acid. The temperature of the must at crushing was 67°, and the maximum reached was 81°, on the third day. The wine was drawn off on the third day, while still a little sweet.

In three weeks the wine was quite dry and nearly clear. At two months it was clear, very rough, and without much flavor. Tastings at three and at four months showed gradual improvement and the development of some bouquet. The lees showed no bad ferments at first, but at six months they were infested with what was apparently a species of *Mucor*, and the wine had become flat and generally deteriorated. At seven months the wine was racked for the third time. At fourteen months it had improved and was bright, but the odor was still not good. At this time it was mature and was put in glass. At three years and a half the bottled wine was tasted and found to be bright and without deposit, not quite clean-tasting, with little bouquet, but good flavor. The wine showed good qualities, but was not alcoholic enough to be a good keeper.

No. 1516. *Refosco*, from Mission San José. Received October 1, 1891, in good condition. There were 106 pounds crushed, and the must showed 24.45% of solid contents by spindle and 0.74% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 87°, on the fourth day. On the sixth day the wine was drawn off nearly dry.

At one month the wine was clear, with good aroma, clean taste, and full acid. At six weeks the wine was racked and put in the cellar; the lees were sound, but showed some *S. pastorianus*. At three months the wine was clear, but tasted a little flat, and, as the lees showed some filaments, it was pasteurized. Two months after pasteurizing the wine was clear, much improved—a fair wine, of good acid and body. It was racked twice after pasteurizing, and at ten months part was put in bottle. At sixteen months the rest was bottled. At three years and a half, the wine first bottled was sound, but very raw. The later bottling was bright and of good flavor and a little bouquet—not a fine wine, but a good ordinary wine, with full acid and astringency.

No. 1584. *Refosco*, from Mission San José. Received October 16, 1891, in fair condition. Only 37 lbs. of grapes were crushed. The must showed 24.45% of solid contents by spindle, and 0.50% of acid. The temperature of the grapes at crushing was 69°, and the maximum reached was 81°, on the third day. The wine was drawn off on the fourth day, dry.

At one month the wine was clear, but tasted moldy. At four months it was racked for the second time, and the lees were sound; the taste had not improved, and was slightly bitter. At five months the lees showed a little "graisse," but at seven months the wine had improved, and the taste of mold had almost disappeared. On account of the smallness of the sample (two gallons) the wine was bottled at seven months. Three years after bottling the wine was bright, of good color, high bouquet, and good flavor, perfectly sound, but with somewhat harsh acid, and not quite fresh-tasting. It was, however, remarkably well kept, considering the smallness of the original sample.

No. 1615. *Refosco*, from Tulare station. Received August 29, 1892, in very good condition, mature, and with a few half-dried grapes. There were 290.5 lbs. crushed and put in the fermenting-vat at a temperature of 65°. The must showed 21.5% of solid contents by spindle and 0.48% of acid. The maximum temperature reached was 95°, on the sixth day. On the seventh day the wine was drawn off dry.

At one month the wine was very clear, rough, clean-tasting, and perfectly dry. At four months it was bright, with rich aroma and flavor, medium acid, and high astringency. At six months it was racked for the second time and was in good condition, and retained its good quality. Tastings at nine, eleven, and sixteen months showed gradual improvement and development. At the last date it was bright, nearly mature and one of the best of the Tulare wines. Four months later the wine was bottled. At two years and a half the wine in bottle was bright, with sufficient color, some bouquet and flavor, very clean-tasting, with low acid, high astringency; altogether a very creditable table wine alone, but would make an excellent blend with some acid, highly flavored wine of Claret type. This wine was distinguished particularly from most Tulare wines by its exceptionally clean after-taste; it was distinctly a wine "che finisce bene."

No. 1650. *Refosco*, from Paso Robles station. A sample for must analysis was received September 16, 1892, in good condition. The must showed 21.75% of solid contents by spindle and 0.75% of acid.

No. 1707. *Refosco*, from Mission San José. Received October 5, 1892, in fair condition. The must showed 22.8% of solid contents by spindle and 0.67% of acid. The temperature of the 160 lbs. crushed was 69°, and the maximum reached was 92°, on the third day. The wine was dry on the fourth day, when it was drawn off.

At three weeks the wine was clear and dry, and at one month was racked and taken to the cellar. At three months the wine was bright, with good aroma and flavor, high acid and astringency. The wine remained in good condition, and at six months was racked for the second time. At eight months it was bright and a very good wine. Tastings at ten and fourteen months showed that it remained in good condition. At eighteen months it tasted mature and was bottled.

No. 1785. *Refosco*, from Mission San José. Received October 21, 1892, in poor condition. The must showed 23.5% of solid contents by spindle and 0.57% of acid. The grapes were fermented with No. 1786, Marzemino, in the proportion of Refosco 47 lbs. and Marzemino 14.5 lbs. The temperature of the grapes at crushing was 64°, and the maximum reached was 81°, on the fourth day. The wine was drawn off on the fifth day.

At one month the wine was clear and was racked and taken to the cellar. At three months it was bright, with good bouquet and flavor, medium acid, and full astringency—a clean-tasting and generally successful blend. At five months it was racked for the third time, and at seven months it had developed well and was an excellent, clean-tasting wine, considering the smallness of the sample. At thirteen months it was still good and mature, but a little *eventé*. A month later it was bottled.

No. 1884. *Refosco*, from Paso Robles station. Received September 21, 1893, in good condition. The bunches were of medium size, very loose, but not coulured; the berries were also of medium size, with rather soft, juicy flesh, sweet, mature, but without much flavor. The must showed 21.9% of solid contents by spindle and 0.58% of acid. There were 130 lbs. of grapes crushed. The temperature at crushing was 68°, and the maximum reached was 87°, on the third day. The wine was nearly dry on the fourth day, and was drawn off on the fifth.

At three weeks the wine was nearly clear, but had a slightly moldy taste; it was racked and taken to the cellar. At four months it was bright, with some bouquet and flavor, high acid and tannin—a fresh-tasting and agreeable but rough wine. It was racked for the second time at four months, and at eight months it was a good wine, but tasted a little green. At eleven months it had improved, and had developed some bouquet, but was not mature. An examination of the lees showed *S. pastorianus*. At seventeen months the wine was in good order—a good, sound wine, with some flavor and bouquet, good color; its chief faults were a slight greenness and a faint after-taste of mold. A month later it was racked, and a part put in bottle.

No. 1930. *Refosco*, from Tulare station. Received October 13, 1893, in good condition. The bunches were large, loose, winged; the berries of medium size, very ripe, sweet, and with little acid. The temperature of the 362 lbs. crushed was 67°, and the maximum reached was 96°, on the third day. On the fourth day the wine was dry, and was drawn off on the fifth. The must at crushing showed 22.85% of solid contents by spindle and 0.41% of acid.

At one month the wine was clear, very astringent, of good flavor, and had still a slight sweetness. At this time it was racked and taken to the cellar. At four months it was bright, dry, with some bouquet, good flavor, high astringency, and clean taste. It was racked again at five months, and at seven months it retained its good qualities and was, perhaps, the best of the Tulare wines. At ten months the lees showed a few filaments, but the wine was quite bright and tasted perfectly sound; it was smooth and agreeable, with some bouquet and fair color. It was racked, and continued to improve. At sixteen months it was a full and agreeable wine, not quite mature. Two months later it was racked, and part of it put in bottle.

No. 1949. *Refosco*, from Mission San José. A sample for must analysis was received October 14, 1893, in poor condition. The must showed 23.7% of solid contents by spindle and 0.63% of acid.

No. 2053. *Refosco*, from Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were of medium size, conical, well filled; the berries oval, fleshy, very sweet, commencing to dry, tasted a little cooked.

No. 2107. *Refosco*, from Cupertino. A sample for must analysis was received November 5, 1893, in good condition. The bunches were small, conico-cylindrical, sometimes branched, well filled, but not compact; the berries were of under-medium size, slightly elongated, crisp, with thin skin, and mature. The must showed 25.9% of solid contents by spindle and 0.42% of acid.

No. 2117. *Refosco*, from Cupertino. A sample for must analysis was received November 5, 1893, in good condition. The bunches were small, conical, slightly shouldered, well filled, not compact, on long, woody, colored peduncles; the berries were small, nearly round, on slender pedicels. This variety was very ripe and commencing to dry up; it is very distinct from No. 2107.

MARZEMINO.

(See Vit. Rept. 1887–89, p. 164.)

This variety has proved one of the poorest bearers among the Italian varieties. It is a good grower and does not suffer from coulure, but it has failed to bear at any of the stations where it has been tested. It attains a lower percentage of both sugar and acid than most of its congeners, averaging at Cupertino 22.7% of sugar and 0.67% of acid, and at Mission San José 22.77% of sugar and 0.63% of acid. It gives a wine of good color and very high tannin, but not possessed of high enough quality to offset its failure to bear. At Fresno the must has averaged 24.76% of sugar and 0.40% of acid.

Analyses of Musts and Wines.

MARZEMINO.	Date of Picking	MUST.				WINE.	
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Tannin	Total Acid as Tartaric at Pressing.
1890—No. 1231. Fresno	Aug. 23	23.41	23.61	.38	.33	------	------
No. 1293. Cupertino	Oct. 1	21.10	------	.89	.28	------	------
No. 1358. Mission San José	Oct. 12	23.05	------	.71	------	------	------
1891—No. 1470. Fresno	Aug. 29	26.10	------	.41	------	------	------
1892—No. 1786. Mission San José	Oct. 18	22.80	------	.61	------	------	------
1893—No. 1997. Mission San José	Oct. 19	22.60	------	.71	------	.413	.69
No. 2119. Cupertino	Nov. 5	21.50	------	.69	------	.355	.68
1894—No. 2243. Mission San José	Oct. 5	19.50	------	.67	------	------	------

COLOR READINGS.

MARZEMINO.	At Pressing.	One Month.	Two Months.	Three Months.	Four Months.	Five Months.
1891—No. 1470. Fresno	69.0 2VR	27.0 4VR	28.6 4VR	34.8 5VR	22.0 R	23.0 R–1R
1893—No. 1997. Mission San José	125.0 VR					
No. 2119. Cupertino	105.0 1VR					

RECORD OF TREATMENT.

No. 1231. *Marzemino*, from Margherita Vineyard, Fresno. A sample for must analysis arrived August 25, 1890, in excellent condition, and mature. The must showed 23.21% of solid contents by spindle and 0.38% of acid.

No. 1293. *Marzemino*, from Cupertino. A sample for must analysis was received October 3, 1890, in very good condition. The must showed 21.1% of solid contents by spindle and 0.89% of acid.

No. 1358. *Marzemino*, from Mission San José. A sample for must analysis arrived October 14, 1890, in fair condition, and mature. The must showed 23.05% of solid contents by spindle and 0.71% of acid.

No. 1470. *Marzemino*, from Margherita Vineyard, Fresno. A sample for must analysis and color test was received August 31, 1891, in good condition. The must showed 26.1% of solid contents by spindle and 0.41% of acid.

No. 1786. *Marzemino*, from Mission San José. A sample for must analysis and color test was received October 21, 1892, in poor condition. The must showed 22.8% of solid contents by spindle and 0.61% of acid.

No. 1997. *Marzemino*, from Mission San José. A sample for must analysis and for color and tannin tests was received October 19, 1893, in good condition, and mature. The bunches were over medium in size, pyramidal to conical, heavily winged or shouldered, well filled, but not compact; the berries were of medium size, round, on very slender pedicels, and had plenty of acid. The must showed 22.6% of solid contents by spindle and 0.71% of acid.

No. 2119. *Marzemino*, from Cupertino. A sample for must analysis and color and tannin tests was received November 5, 1893, in good condition. The bunches were of medium size, long cylindrical, close; the berries of medium size, round, commencing to shrivel, soft, and with thick skin. The must showed 21.5% of solid contents by spindle and 0.69% of acid.

LAGRAIN.

(See Vit. Rept. 1887–89, p. 247.)

This variety makes a heavy-bodied, astringent wine, of good color. At Tulare it has surpassed all other varieties in the matter of color, being superior to the Petit Bouschet, and, though having less than the St. Macaire to start with, it is much more stable and of better tint. This quality of retaining its color, which it has in spite of its somewhat low acid, is invaluable for Tulare; it would make an excellent blend for coloring purposes. The average composition of the must at Tulare has been 25.95% of sugar and 0.42% of acid, and the vine has borne between three and four tons per acre. At the Bay region stations the vine has not borne well, and as a coloring grape is surpassed there by many others which are better bearers.

ANALYSES OF MUSTS AND WINES.

LAGRAIN.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
							By Weight	By Volume		At Pressing	At Six Months	
1890—No. 1233.	Fresno	Aug. 23	25.10	24.86	.44	.38						
No. 1411.	Cupertino	Oct. 28	22.60		.51							
No. 1419.	Mission San José	Oct. 29	25.65		.72	.20	12.62	15.50	.313	.84	.55	3.82
1892—No. 1693.	Tulare	Sept. 26	25.65		.39							
No. 1788.	Mission San José	Oct. 18	21.30		.64							
1893—No. 2002.	Tulare	Oct. 22	25.40	24.86	.43	.45	9.92	12.36	.272	.55	.85	3.70
No. 2126.	Cupertino	Nov. 5	24.10		.68				.419			
1894—No. 2258.	Mission San José	Oct. 5	22.20		.66				.342			
No. 2320.	Tulare	Oct. 15	26.70		.43							

COLOR READINGS.

LAGRAIN.		At Pressing.	One Month.	Two Months.	Three Months.	Four Months.	Five Months.
1890—No. 1419.	Mission San José	149.0 VR	74.1 VR	60.6 4VR	49.4 3VR		
1893—No. 2002.	Tulare	95.2 VR	60.6 1VR	60.6 1VR	55.5 1VR	52.0 2VR	53.5 3VR
No. 2126.	Cupertino	121.0 1VR					

RECORD OF TREATMENT.

No. 1233. *Lagrain*, from Fresno. A sample for must analysis arrived August 25, 1890, in good condition but for a few dried grapes; very sweet. The must showed 25.1% of solid contents by spindle and 0.44% of acid.

No. 1411. *Lagrain*, from Cupertino. A sample for must analysis was received October 30, 1890, in good condition, but a little soft and overripe. The must showed 22.6% of solid contents by spindle and 0.51% of acid.

No. 1419. *Lagrain*, from Mission San José. Received October 30, 1890, in good condition and ripe. The must showed 25.65% of solid contents by spindle and 0.72% of acid. Only a small quantity of grapes was received; they were fermented as a color sample.

No. 1693. *Lagrain*, from Tulare station. A sample for must analysis was received September 29, 1892, in good condition. The must showed 25.65% of solid contents by spindle and 0.39% of acid.

No. 1788. *Lagrain*, from Mission San José. A sample for must analysis arrived October 21, 1892, in poor condition. The must showed 21.3% of solid contents by spindle and 0.64% of acid.

No. 2002. *Lagrain*, from Tulare station. Received October 23, 1893, in good condition. The bunches were small, irregular, well filled; the berries of medium size, well colored, very sweet, overripe. The must showed 25.4% of solid contents by spindle and 0.43% of acid. The temperature of the must at crushing was 67°, and the maximum reached was 81°, on the second day. The murk was nearly dry on the fourth day, when it was pressed.

Three weeks after pressing the wine was still a little sweet, but clear. It was racked and taken to the cellar. At three months it was bright, full-bodied, clean-tasting, with medium acid and astringency, very promising, but only three gallons in quantity. Three months later it was still bright and had developed some bouquet, but it also acquired some volatile acid. After this it deteriorated, on account of the smallness of the keg.

No. 2126. *Lagrain*, from Cupertino. A sample for must analysis arrived November 7, 1893, in good condition, but commencing to dry up. The bunches were of medium size, conical, winged, loose; the berries small, round, and soft. The must showed 24.1% of solid contents by spindle and 0.68% of acid.

GROS MANSENC.

(See Vit. Rept. 1887-89, p. 66.)

This variety has sometimes, on account of the many qualities they have in common, been confounded with the Tannat, from which, however, it is perfectly distinct. The Mansenc, like the Tannat, is a vigorous grower, a fair to good bearer with long-pruning, and produces a must (where the grapes ripen properly) rich in sugar and acid. At Mission San José the grapes seldom ripen thoroughly, but at Cupertino and in parts of Napa and Sonoma they do better. At Cupertino the average composition of the must has been 24% of sugar and 0.77% of acid; at Mission San José, 22% of sugar and 1.20% of acid; at Tulare and Fresno, 25% of sugar and 0.67% of acid; at the Amador station, 24% of sugar and 1.12% of acid.

The wine is easily fermented and a robust keeper; in its roughness and high acidity it resembles the North Italian varieties. It has very intense color, and where the grapes ripen properly it should be very useful as a blending wine. It is not so astringent as the Tannat, but has more color and acidity, and develops more quickly.

ANALYSES OF MUSTS AND WINES.

GROS MANSENC.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—No. 1243.	Fresno	Aug. 26	23.25	22.05	1.15	.40	9.27	11.55	.180	.75	.59	2.95
No. 1277.	Cupertino	Oct. 1	23.25		1.20	.31	9.34	11.64	.313	.85	.57	2.82
No. 1339.	Mission San José	Oct. 12	23.30		1.25	.17	9.20	11.45	.210	1.09	.62	2.82
1891—No. 1468.	Fresno	Aug. 29	24.35		.88		9.70	12.09	.200	.75	.55	3.05
No. 1547.	Paso Robles	Oct. 6	21.97	21.00	.81							
No. 1562.	Mission San José	Oct. 6	20.70	19.54	1.62		7.99	10.00	.275	1.32	.95	3.20
1892—No. 1680.	Tulare	Sept. 18	24.35		.36							
No. 1763.	Paso Robles	Oct. 11	23.70		.61							
No. 1766.	Mission San José	Oct. 12	20.20	19.20	1.39		7.78	9.73	.242	1.15	1.11	3.20
1893—No. 1833.	Amador station	Sept. 8	23.50		1.31	.23			.393	.91		
No. 1899.	Tulare	Sept. 29	26.10	25.76	.47	.49	9.92	12.36	.294	.50	.51	3.60
No. 2083.	Paso Robles	Nov. 4	23.70	22.67	.68	.29	9.20	11.45	.240	.65	.54	2.85
1894—No. 2198.	Amador station	Sept. 23	24.20		.93							
No. 2204.	Tulare	Sept. 25	26.70		.47							
No. 2344.	Mission San José	Oct. 22	22.60		.88							

COLOR READINGS.

GROS MANSENC.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1891—No. 1468.	Fresno	43.0	3VR	27.2	3VR	20.5	3VR	21.6	3VR	22.2	3VR	23.0	4VR
No. 1562.	Mission San José	154.0	1VR	120.0	2VR	108.0	3VR	61.0	3VR	85.0	2-3VR		
1892—No. 1766.	Mission San José	166.0	2VR	190.0	2VR	125.0	3VR	108.0	2VR	93.0	2VR	88.8	2VR
1893—No. 1833.	Amador station	83.0	VR	83.0	VR								
No. 1899.	Tulare	75.5	VR	24.4	2VR	26.3	2VR	24.4	3VR	24.1	5VR	20.0	5VR
No. 2083.	Paso Robles	53.5	1-2VR	41.2	1-2VR	32.5	3VR	26.0	3-4VR	19.2	4VR		

RECORD OF TREATMENT.

No. 1243. *Gros Mansenc*, from Margherita Vineyard, Fresno. Received August 26, 1890, in good condition, but very irregular in the degree of ripeness of the bunches. The must showed 23.25% of solid contents by spindle. The temperature of the grapes at crushing was 66°, and the maximum attained was 86°, on the third day. The murk was dry on the fifth day, when it was drawn off.

The wine was long in clearing, and fermented gently for over two months after it was drawn off. At nine weeks it was clear, had a fairly agreeable, but not marked, flavor, full acid and tannin, and good but not very deep color. At four months it was bright and had been racked twice; the lees showed a good deal of lactic germs; this was also slightly perceptible to the taste; on this account the wine was pasteurized. The wine was racked twice more during the year, and gradually improved and became bright, developed a little bouquet, and lost its slight touch of lactic taint. At fourteen months it was bright, vinous, well flavored, possessed of a little bouquet, and, though highly astringent, was almost mature. At eighteen months it was bottled. Two years after bottling the wine was bright and in first-class order, smooth, clean-tasting, of good body and flavor, though neutral; it had become much smoother and had acquired some delicacy in aging.

No. 1277. *Gros Mansenc*, from J. T. Doyle, Cupertino. Received October 2, 1890, in fair condition. The bunches were small and loose, the berries small; the grapes were not mature and still wet with the rain. The must showed 23.25% of solid contents by spindle. The temperature of the must at crushing was 66°, and the highest temperature reached was 89°, on the fourth day. The murk was drawn off on the sixth day.

The wine was rather slow in clearing, but in two months it was bright, of good flavor and aroma, clean taste, good body and alcohol, and high acid and astringency. At four months the wine had been racked twice, and was bright, with good bouquet and, though the lees showed a few lactic ferments, the taste was unaffected. A week later it was pasteurized for safety. Three months after pasteurizing the wine was bright, perfectly sound, and, though still rough, maturing well. At fifteen months it was nearly mature and of very good quality. Some of the wine was bottled at eighteen months and some of it at twenty-six. At three years the wine was tasted, and that first bottled was found to be sound, but not clear, and was raw-tasting; the second bottled was clearer, of good bouquet and flavor, smooth and agreeable, its general quality very good.

No. 1339. *Gros Mansenc*, from Mission San José. Received October 14, 1890, in good condition, but not quite ripe. The must showed 23.3% of solid contents by spindle. The temperature of the grapes at crushing was 66°, and the maximum temperature reached was 94°, on the fourth day. At the end of the fourth day the murk was nearly dry, and was drawn off.

Three weeks after pressing the wine was clear. At six weeks after pressing it showed good bouquet, pleasing flavor, full astringency, very high acid, its general character rough, but promising. At four months it had been racked twice, and was bright, with strong and pleasing bouquet, full flavor, generally improved and smoother, but with extremely high acid. An examination of the lees at five months showed large quantities of *S. pastorianus.* The wine remained bright and sound, and continued to improve up to the age of seventeen months, when some of it was bottled; the rest was bottled at twenty-two months. At three years and three months—twenty-two and seventeen months after bottling, respectively—both samples were tasted. They were both in good order, with high bouquet and full flavor, rather high acid, but clean-tasting and of excellent quality; the second bottling was the smoother.

No. 1468. *Gros Mansenc*, from Margherita Vineyard, Fresno. Received August 31, 1891, in good condition. The must showed 24.35% of solid contents by spindle. The temperature of the must at starting was 68°, and the highest temperature reached was 84°, on the fourth day. It was somewhat slow in fermenting through, and was pressed on the seventh day while still a little sweet.

Two weeks after pressing the wine was nearly clear and quite dry. It was very rough and highly acid, but improved quickly and soon developed some bouquet. At four months it was racked for the second time; it was bright, with good bouquet and flavor, full acid, rough, but clean-tasting. At six months it had toned down considerably, and was nearing maturity. At nine months it was bright, and, though somewhat lacking in freshness, a good wine. It retained its good qualities, but did not improve much up to seventeen months, when it was bottled. At three years and a half the wine was bright, well flavored, with a little bouquet, of good color and clean taste, and had made no deposit in bottle. Some bottled at twelve months was sound, but not clear, and had made a heavy deposit.

No. 1547. *Gros Mansenc*, from Paso Robles station. A sample for must analysis was received October 8, 1891, in good condition. The grapes were mature, small, in medium-sized bunches. The must showed 21.97% of solid contents by spindle.

No. 1562. *Gros Mansenc*, from Mission San José. Received October 9, 1891, in good condition. The must showed 20.7% of solid contents by spindle. The temperature of the must at starting was 60°, and the highest temperature reached was 90°, on the fourth day. The murk was nearly dry on the fifth day, when it was drawn off.

A month after pressing the wine was clear, possessed of good bouquet and flavor and excessively high acid. At four months an examination of the lees showed much *S. pastorianus*. At five months it was bright, with rich, vinous bouquet and flavor, adequate astringency, but too much acid. It was racked three times during the first ten months, a portion bottled, and at sixteen months was much toned down and nearly mature. At eighteen months part of it was bottled and the remainder racked. At twenty-two months the wine that remained in wood was in excellent condition and of good quality; its only fault was its somewhat excessive acidity. It made an excellent wine for dilution. It was mature and was bottled. At three years and a half the wine bottled at ten months was bright, of good color, high bouquet, good flavor, medium astringency, and extremely high acid—a very good wine, but much too acid to be used alone. The wine bottled at eighteen months and at twenty-two months differed little from the other, but was not quite so full flavored and was clean-tasting.

No. 1680. *Gros Mansenc*, from Tulare station. A sample for must analysis was received September 21, 1892, in good condition. The must showed 24.35% of solid contents by spindle.

No. 1763. *Gros Mansenc*, from Paso Robles station. Received October 14, 1892, in good condition. The must showed 23.7% of solid contents by spindle. The grapes were fermented with No. 1761, Tannat, from Paso Robles.

No. 1766. *Gros Mansenc*, from Mission San José. Received October 15, 1892. The must showed 20.2% of solid contents by spindle. The temperature of the must at crushing was 58°, and the highest temperature reached was 85°, on the fifth day. The murk was dry on the sixth day, and was drawn off.

Three weeks after pressing the wine was clear, very rough, and extremely acid. At three months it was bright, of good body, harsh, and with a moldy taste, due to the bad condition of the grapes when crushed. The wine was racked four times, and improved a little, but never quite lost its moldy taste and retained its harsh acidity. It was bottled at eighteen months.

No. 1833. *Gros Mansenc*, from Amador station. A sample for must analysis was received September 11, 1893, in good condition. The grapes were very small and not quite mature. The must showed 23.5% of solid contents by spindle.

No. 1899. *Gros Mansenc*, from Tulare station. Received September 30, 1893. The grapes arrived in good condition and well matured, but with little flavor. The bunches were small, from loose to compact, the berries of medium size, with rather thick skin and little color. The must showed 26.1% of solid contents by spindle. The temperature of the must at crushing was 66°, and the maximum reached was 82°, on the third day. The murk was dry on the fifth day, and was drawn off.

At one month the wine was nearly clear, smooth, and pleasing, but not perfectly dry. At four months it was clear, of good color, acid, and astringency, but not perfectly clean-tasting. The quantity was rather too small for a fair test. At seven months the wine was sound and in good order, but a little flat.

No. 2083. *Gros Mansenc*, from Paso Robles station. Received November 6, 1893, in fair condition, a few of the grapes moldy. The bunches were of medium size, compact, conical, shouldered; the berries small, juicy, with high acid, and not quite mature. The must showed 23.7% of solid contents by spindle. The temperature of the must at crushing was 62°, and the maximum reached was 83°, on the fourth day. The murk was nearly dry on the fifth day, and was pressed.

In one month from crushing the wine was clear. At three months it was racked for the second time; it was bright, with good bouquet and rich flavor, clean taste, medium astringency, full, pleasant acid, and in general a light, fresh wine of good quality. At six months it had developed well and was a wine of distinctive character and good quality.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF NORTH ITALIAN TYPE—RED.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At 6 to 8 Months	Body
	Nebbiolo.										
1285	Cupertino	1890	22.80		.82	.22					
1364	Cupertino	1890	23.70		.96						
2039	Cupertino	1893	23.70		1 26			.387			
2058	Cupertino	1893	23.30		1.14			.352			
1695	Tulare	1892	22.80		.80						
1700	Tulare	1892	25.40		.41						
1857	Amador station	1893	20.60		1.15						
1858	Amador station	1893	20.20		1.07						
1938	Paso Robles	1893	25.90	24.97	.53	.34		.281			
2277	Asti, Sonoma County	1894	22.20	21.38	.99	.31					
1575	Asti, Sonoma County	1891	26.90	27.65	.45	.26					
	Average, Cupertino		**23.25**		**.89**			**.369**			
	Average, Tulare		**24.10**		**.62**						
	Average, Amador station		**20.40**		**1.11**						
	Barbera.										
1324	Cupertino	1890	27.65		.50						
2040	Cupertino	1893	25.90		1.32			.441			
1445	Tulare	1891	25.65		.77						
1675	Tulare	1892	24.55	25.76	.65	.71	12.18	.124		.56	3.20
1931	Tulare	1893	23.50	21.22	1.03	.41					
2211	Tulare	1894	24.80	23.61	.60		12.50	.204	.65	.52	3.10
1573	Asti, Sonoma County	1891	28.80	28.52	.75	.40	14.20	.265	.85	.52	3.25
2276	Asti, Sonoma County	1894	25.30	24.12	.79						
	Average, Tulare		**25.00**	**24.68**	**.67**	**.71**	**12.34**	**.164**	**.65**	**.54**	**3.15**
	Average, Asti, Sonoma County		**27.05**	**26.32**	**.77**	**.40**	**14.20**	**.265**	**.85**	**.52**	**3.25**

SUMMARY OF ANALYSES OF MUSTS AND WINES OF NORTH ITALIAN TYPE—RED—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At 6 to 8 Months	Body
	Bonarda.										
1362	Cupertino	1890	22.82	--------	.72	.22	11.73	.400	.71	.32	2.70
1384	Cupertino	1890	25.20	--------	1.02	.90	12.36	.286	--------	.60	2.58
1385	Cupertino	1890	24.45	--------	1.09	--------	--------	--------	--------	--------	--------
1599	Cupertino	1891	24.80	--------	.91	.33	12.36	.356	.83	.83	3.35
2108	Cupertino	1893	25.00	--------	.68	--------	--------	.496	--------	--------	--------
2110	Cupertino	1893	24.80	--------	.78	--------	--------	.253	--------	--------	--------
1869	Paso Robles	1893	22.80	19.89	.45	.41	10.08	.134	.40	.57	2.80
2310	Tulare	1894	26.50	--------	.39	--------	--------	--------	--------	--------	--------
	Average, Cupertino	--------	**24.52**	--------	**.82**	**.48**	**12.15**	**.358**	**.77**	**.58**	**2.88**
	Fresa.										
1327	Cupertino	1890	23.90	--------	.94	.21	12.18	.451	.97	.53	3.08
1600	Cupertino	1891	25.20	24.64	.77	.45	12.46	.440	--------	.70	3.05
2130	Cupertino	1893	25.20	--------	.88	--------	--------	.265	--------	--------	--------
1469	Fresno	1891	28.20	28.33	.50	.50	14.00	--------	.80	.50	3.82
1553	Paso Robles	1891	25.90	--------	.43	--------	--------	--------	--------	--------	--------
1643	Paso Robles	1892	24.14	--------	.76	--------	--------	--------	--------	--------	--------
1913	Paso Robles	1893	24.80	23.61	.66	.68	12.00	.285	.70	.43	2.80
1703	Tulare	1892	24.35	--------	.41	--------	--------	--------	--------	--------	--------
1976	Tulare	1893	27.35	--------	.38	.31	--------	--------	--------	--------	--------
2318	Tulare	1894	24.80	--------	.41	--------	--------	--------	--------	--------	--------
1830	Amador station	1893	20.40	--------	.89	.22	--------	.461	--------	--------	--------
2175	Amador station	1894	23.70	--------	.68	--------	--------	--------	--------	--------	--------
	Average, Cupertino	--------	**24.77**	**24.64**	**.86**	**.33**	**12.32**	**.385**	**.97**	**.62**	**3.07**
	Average, Paso Robles	--------	**24.95**	**23.61**	**.62**	**.68**	**12.00**	**.285**	**.70**	**.43**	**2.80**
	Average, Tulare	--------	**23.50**	--------	**.40**	**.31**	--------	--------	--------	--------	--------
	Average, Amador station	--------	**22.05**	--------	**.78**	**.22**	--------	**.461**	--------	--------	--------

	Croetto.										
2136	Cupertino	1893	24.70		.68						
	Moretto.										
1633	Tulare	1892	24.01		.62						
1889	Tulare	1893	22.40	21.22	.38	.59		.224			
1906	Tulare	1893	23.25	20.24	.75	.32					
2319	Tulare	1894	26.30		.53						
1852	Amador station	1893	19.70		.77			.208			
2177	Amador station	1894	24.70		.56						
1926	Paso Robles	1893	24.60	23.32	.43	.35		.214			
2215	Paso Robles	1894	22.80		.68						
	Average, Tulare		**23.74**	**20.73**	**.57**	**.46**		**.224**			
	Average, Amador station		**22.20**		**.66**			**.208**			
	Average, Paso Robles		**23.70**	**23.32**	**.55**	**.35**		**.214**			
	Favorita.										
2123	Cupertino	1893	24.80		1.04						
	Tadone.										
2106	Cupertino	1893	23.10		.94						
	Refosco.										
1287	Cupertino	1890	23.90		.55	.27					
1318	Cupertino	1890	25.20		.62	.34	13.27	.244	.66	.42	2.78
1390	Cupertino	1890	24.12		.55						
1416	Cupertino	1890	29.50		1.06	.28					
2053	Cupertino	1893	26.50		.43			.323			
2107	Cupertino	1893	25.90		.42			.425			
2117	Cupertino	1893	26.30		1.07						
1316	Mission San José	1890	27.55		.71						
1343	Mission San José	1890	26.50		.63	.22					
1516	Mission San José	1891	24.45	24.53	.74		12.09	.220	.75	.35	3.04
1707	Mission San José	1892	22.80	22.05	.67	.29	11.18	.229	.63	.49	2.85
1785	Mission San José	1892	23.50		.57						
1949	Mission San José	1893	23.70		.63			.358			
2268	Mission San José	1894	22.40		.47			.173			
2302	Mission San José	1894	23.10		.43						
1584	Mission San José	1891	24.45	22.67	.50		12.00	.220	.48	.70	3.45
1496	Paso Robles	1891	19.30	18.30	.47	.31	9.73	.170	.46	.30	2.80
1650	Paso Robles	1892	21.75		.75						
1884	Paso Robles	1893	21.90	19.89	.58	.28	9.90	.266	.60	.58	2.85
1526	Asti, Sonoma County	1891	25.30	24.12	.39	.33	12.77	.294	.55	.41	2.95
1615	Tulare	1892	21.50	18.58	.48	.30	9.90	.270	.43	.39	3.05
1930	Tulare	1893	22.85	21.47	.41	.49	11.00	.268	.49	.42	2.66

SUMMARY OF ANALYSES OF MUSTS AND WINES OF NORTH ITALIAN TYPE—RED—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At 6 to 8 Months	Body
	Refosco—Continued.										
2171	Tulare	1894	24.00	23.42	.41		11.36	.291	.40	.51	3.10
	Average, Cupertino		**25.12**		**.51**	**.30**	**13.27**	**.244**	**.66**	**.42**	**2.78**
	Average, Mission San Jose		**24.27**	**23.08**	**.58**	**.26**	**11.76**	**.240**	**.62**	**.51**	**3.11**
	Average, Paso Robles		**20.98**	**19.09**	**.60**	**.29**	**9.81**	**.218**	**.53**	**.44**	**2.83**
	Average, Tulare		**22.78**	**21.16**	**.47**	**.39**	**10.75**	**.276**	**.44**	**.44**	**2.93**
	Neiretta.										
2135	Cupertino	1893	22.40		.68						
	Marzemino.										
1231	Fresno	1890	23.41	23.61	.38	.33					
1470	Fresno	1891	26.10		.41						
1293	Cupertino	1890	21.10		.89	.28					
2119	Cupertino	1893	21.50		.69			.355	.68		
1358	Mission San José	1890	23.05		.71						
1786	Mission San José	1892	22.80		.61						
1997	Mission San José	1893	22.60		.71			.413	.69		
2243	Mission San José	1894	19.50		.67						
	Average, Fresno		**24.75**	**23.61**	**.39**						
	Average, Cupertino		**21.30**		**.79**			**.355**	**.68**		
	Average, Mission San Jose		**21.99**		**.67**			**.413**	**.69**		
	Lagrain.										
1233	Fresno	1890	25.10	24.86	.44	.38					
1411	Cupertino	1890	22.60		.51						
2126	Cupertino	1893	24.10		.68			.419			
1419	Mission San José	1890	25.65		.72	.20	15.50	.313	.84	.55	3.82
1788	Mission San José	1892	21.30		.64						
2258	Mission San José	1894	22.20		.66			.342			

1693	Tulare	1892	25.65	-------	.39	-------	-------	-------	-------	-------	-------
2002	Tulare	1893	25.40	24.86	.43	.45	12.36	.272	.55	.85	3.70
2320	Tulare	1894	26.70	-------	.43	-------	-------	-------	-------	-------	-------
	Average, Cupertino	-------	**23.35**	-------	**.59**	-------	-------	**.419**	-------	-------	-------
	Average, Mission San Jose	-------	**23.05**	-------	**.67**	**.20**	**15.50**	**.327**	**.84**	**.55**	**3.82**
	Average, Tulare	-------	**25.91**	**24.86**	**.41**	**.45**	**12.36**	**.272**	**.55**	**.85**	**3.70**
	Gros Mansenc.										
1243	Fresno	1890	23.25	22.05	1.15	.40	11.55	.180	.75	.59	2.95
1468	Fresno	1891	24.35	-------	.88	-------	12.09	.200	.75	.55	3.05
1277	Cupertino	1890	23.25	-------	1.20	.31	11.64	.313	.85	.87	2.82
1339	Mission San José	1890	23.30	-------	1.25	.17	11.45	.210	1.09	.62	2.82
1562	Mission San José	1891	20.70	19.54	1.62	-------	10.00	.275	1.32	.95	3.20
1766	Mission San José	1892	20.20	19.20	1.39	-------	9.73	.242	1.15	1.11	3.20
2344	Mission San José	1894	22.60	-------	.88	-------	-------	-------	-------	-------	-------
1547	Paso Robles	1891	21.97	21.00	.81	-------	-------	-------	-------	-------	-------
1763	Paso Robles	1892	23.70	-------	.61	-------	-------	-------	-------	-------	-------
2083	Paso Robles	1893	23.70	22.67	.68	.29	11.45	.240	.65	.54	2.85
1680	Tulare	1892	24.35	-------	.36	-------	-------	-------	-------	-------	-------
1899	Tulare	1893	26.10	25.76	.47	.49	12.36	.294	.50	.51	3.60
2204	Tulare	1894	26.70	-------	.47	-------	-------	-------	-------	-------	-------
1833	Amador station	1893	23.50	-------	1.31	.23	-------	.393	.91	-------	-------
2198	Amador station	1894	24.20	-------	.93	-------	-------	-------	-------	-------	-------
	Average, Fresno	-------	**23.80**	**22.05**	**1.02**	**.40**	**11.82**	**.190**	**.75**	**.57**	**3.50**
	Average, Mission San Jose	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
	Average, Paso Robles	-------	**23.12**	**21.83**	**.70**	**.29**	**11.45**	**.240**	**.65**	**.54**	**2.85**
	Average, Tulare	-------	-------	**25.76**	**.43**	**.49**	**12.36**	**.294**	**.51**	**.50**	**3.60**
	Average, Amador station	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

AUSTRIAN AND HUNGARIAN TYPE—RED.

(See Vit. Rept. 1887–89, p. 230.)

Perhaps the most valuable of the red grapes cultivated in Austria are the Refosco and the Marzemino. These varieties, however, together with Lagrain, are so distinctly congeneric with those which make the distinct type of North Italian grapes, that they are included in the same group.

The four grapes here classed together are somewhat diverse in character, and should be denominated simply a group rather than a type. They agree, however, in being smooth, quick maturing, and of ordinary quality. The wide range of adaptability of the Zinfandel is not characteristic of the other three, which are successful only in certain favorable localities. The famous Kadarkas has, so far, been a failure here, but has given indications that, under favorable conditions, it is capable of yielding a good wine. It should be tried further in the lower coast counties.

KADARKAS.

(See Vit. Rept. 1887–89, p. 245.)

The locality in California, suitable to the Kadarkas, if such a one exists, has not yet been found. It will occasionally make a good wine in the Bay region, but is generally lacking in color, often in tannin and sugar, and sometimes in acid. Altogether it is very unreliable for any locality where it has been yet tested. The fine quality of the wine, however, which it sometimes makes in favorable years, and its high reputation in eastern Europe, make further experiments under other conditions desirable. At Fresno the vine has not borne well, and the must seems to be low in acid. At Pomona the Kadarkas has just come into bearing, but it gives indications of being very well adapted to the conditions which exist there.

ANALYSES OF MUSTS AND WINES.

KADARKAS.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
							By Weight	By Volume		At Pressing	At Six Months	
1890—No. 1307.	Cupertino	Oct. 6	21.30	------	.72	.27	8.27	10.36	.138	.62	.40	2.58
No. 1418.	Mission San José	Oct. 27	25.85	------	.58	.28	10.35	12.82	.233	.62	.48	3.58
1891—No. 1461.	Fresno	Aug. 29	23.70	23.13	.42	------	------	------	------	------	------	------
1892—No. 1787.	Mission San José	Oct. 18	23.70	------	.68	------	------	------	------	------	------	------
1893—No. 1986.	Mission San José	Oct. 17	22.20	21.80	.68	.20	7.92	9.90	.371	.57	.54	3.10
No. 2042.	Cupertino	Oct. 30	23.20	------	.57	------	------	------	.440	------	------	------
1894—No. 2257.	Mission San José	Oct. 5	20.85	------	.47	------	------	------	.149	------	------	------

COLOR READINGS.

KADARKAS.		At Pressing.	One Month.	Two Months.	Three Months.	Four Months.	Five Months.
1893—No. 1986.	Mission San José	------	20.0 4VR	20.0 4VR	15.8 5VR	5.7 3R(Y)	4.0 (Y)
No. 2042.	Cupertino	45.5 1VR	------	------	------	------	------
1894—No. 2257.	Mission San José	15.0 1R	------	------	------	------	------

Record of Treatment.

No. 1307. *Kadarkas*, from Cupertino. Received October 8, 1890, in good condition—a few grapes cracked by the rain, but none moldy; not quite mature. The must showed 21.3% of solid contents by spindle and 0.72% of acid. The temperature of the grapes at crushing was 65°, and the maximum reached was 86°, on the fourth day. On the fifth day the wine was dry and was racked off.

The wine was somewhat slow in clearing, but at one month, though still cloudy, promised well and possessed a very pleasant aroma and agreeable acid. At three months it had been racked twice, and was bright; but the lees showed some filaments, and the taste was slightly suspicious, so the wine was pasteurized. Otherwise, it had a light, pleasing bouquet, good flavor, medium acid and astringency; generally of good quality. At seven months it had improved; it was bright, clean-tasting, of delicate bouquet, full flavor—a light but harmonious wine of good quality. It was racked twice after this, and at fifteen months was in first-class condition, with full bouquet and flavor, little color, very fresh, and mature. Two months later part was bottled, and at two years the remainder was bottled. At twenty-seven months both bottlings were smooth and agreeable, with very light color; the second bottled was brighter and cleaner-tasting.

No. 1418. *Kadarkas*, from Mission San José. Received October 30, 1890, in good condition, and mature. The must showed 25.85% of solid contents by spindle and 0.58% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 87°, on the fourth day. The wine was racked off the sixth day, when it was dry.

At one month the wine was clear, with strong, pleasing aroma and flavor, good acid, and medium astringency; full-bodied, smooth, and well developed. The lees early showed a few filaments, but the taste was unaffected, and at three months the wine was bright and well developed. At six months the wine had been racked twice, and was in very good order. At thirteen months it was bright, retained a fair color, showed marked and characteristic bouquet and flavor—an excellent wine but for a slight bitterness of after-taste; the wine had kept very well, considering the small quantity (two gallons). At fifteen months it was bottled. One year after bottling the wine was smooth and agreeable, but not quite clean-tasting.

No. 1461. *Kadarkas*, from Margherita Vineyard, Fresno. A sample for must analysis was received August 31, 1891, in good condition. The must showed 23.7% of solid contents by spindle and 0.42% of acid.

No. 1787. *Kadarkas*, from Mission San José. A sample for must analysis arrived October 21, 1892, in poor condition. The must showed 23.7% of solid contents by spindle and 0.68% of acid.

No. 1986. *Kadarkas*, from Mission San José. Received October 19, 1893, in good condition. The bunches were of medium size, regular cylindrical, with one wing about one third the length of the bunch, well filled, but not compact; the berries were of medium size, round, juicy, thin-skinned, well colored, and mature. The must showed 22.2% of solid contents by spindle and 0.68% of acid. The temperature of the grapes at crushing was 61°, and the maximum reached was 81°, on the fourth day. On the fifth day the wine was drawn off, dry.

The wine remained cloudy for some time, but at six weeks, when it was racked for the first time, was clear. At three months it was clear, but not bright, had full acid and astringency and clean taste. After this it improved, was at first somewhat green, but at ten months had developed some bouquet, had good flavor, and was altogether a good wine, though lacking in color.

No. 2042. *Kadarkas*, from Cupertino. A sample for must analysis and for color and tannin tests arrived October 31, 1893, in good condition. The bunches were small, cylindrical, sometimes branched, close; the berries were medium to large in size, rather pulpy, but soft, sweet, and well colored. The must showed 23.2% of solid contents by spindle and 0.57% of acid.

GROSSBLAUE.

(See Vit. Rept. 1883–84, p. 92; 1885–86, p. 75; 1887–89, p. 249.)

Synonyms: Kölner; Blauer Kölner.

Description.—Vine vigorous, with slender, reddish-brown canes; leaves small, five-lobed, split to the middle, red-veined, woolly below and on the petiole, lateral sinuses very obtuse at the base, and often with a large tooth; bunches large, pyramidal, and close; berries large, dark-colored, sweet, and agreeable as an eating-grape. Both the berries and the leaves are smaller in California than they are described as being in Europe. The wine, which in Europe is lacking in color, is here remarkable for both the quality and the intensity of the color. These differences are almost too great to be laid to change of local conditions, and throw some doubt on the identification of the variety.

Later experiments with this variety show that with proper care a good wine can be made from it. The wine always has a beautiful and stable color, good acid and astringency. When the grapes are allowed to attain complete maturity, with 24% to 25% of solid contents, the wine is very smooth and soft, somewhat of Burgundy character, but with more of a Claret color. The chief defects of the grapes are a somewhat neutral character and a tendency to coulure, unless pruned long.

ANALYSES OF MUSTS AND WINES.

GROSSBLAUE.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
						By Weight	By Volume		At Pressing	At Six Months	
1890—No. 1381. Mission San José	Oct. 18	25.10		.77	.27	10.07	12.54	.263	.62	.34	3.08
1891—No. 1555. Paso Robles	Oct. 6	26.60		.36							
No. 1604. Mission San José	Oct. 27	24.90	25.19	.54		10.26	12.73	.320	.45	.47	3.35
1892—No. 1682. Tulare	Sept. 19	24.80		.33							
No. 1751. Paso Robles	Oct. 11	22.60		.49							
No. 1768. Mission San José	Oct. 13	20.00	19.08	.83		8.34	10.42	.262	.77	.53	2.30
1893—No. 1829. Amador station	Sept. 7	21.95		.95				.451			
No. 1881. Paso Robles	Sept. 14	21.50	21.22	.76	.30	8.64	10.58	.182	.59	.59	3.20
No. 1937. Tulare	Oct. 12	25.00	24.64	.49	.43			.417			
No. 2129. Cupertino	Nov. 3	23.70		.82				.249			
1894—No. 2253. Mission San José	Oct. 5	22.20		.68					.65		
No. 2285. Amador station	Oct. 6	25.45		.58							
No. 2323. Tulare	Oct. 15	25.00		.46							

COLOR READINGS.

GROSSBLAUE.	At Pressing.	One Month.	Two Months.	Three Months.	Four Months.	Five Months.
1891—No. 1604. Mission San José	102.6 1VR	95.2 1VR	44.0 2VR			
1892—No. 1768. Mission San José	95.2 2VR	83.3 1VR	65.2 1VR	59.7 1VR	60.6 1VR	49.4 1VR
1893—No. 1829. Amador station	115.0 VR	115.0 VR				
No. 1881. Paso Robles	45.5 VR	37.4 1VR	27.5 3VR	23.6 3VR	23.8 3VR	19.4 5VR
No. 1937. Tulare	36.0 1VR					
No. 2129. Cupertino	70.2 2VR					
1894—No. 2253. Mission San José	85.1 VR					

RECORD OF TREATMENT.

No. 1381. *Grossblaue,* from Mission San José. Received October 20, 1890, in bad condition, crushed and moldy. The must showed 25.1% of solid contents by spindle and 0.77% of acid. The temperature of the must at crushing was 68°, and the maximum reached was 89°, on the second day. On the fourth day the murk was dry, and was drawn off.

At one month the wine was nearly clear, with low acid, good astringency and flavor, but a little taste of mold. At six weeks the lees were sound, and the wine was racked. At three months the lees showed a few filaments, and the wine was pasteurized; it was bright, but had not improved much. At seven months it was in good condition, much improved, moldiness nearly gone, full-bodied, but without much character. It remained in good order for some months after this, but at fifteen months, when it was bottled, it had deteriorated, tasted flat, and lacked bouquet.

No. 1555. *Grossblaue,* from Paso Robles station. Received October 8, 1891, in good condition, and mature. The bunches were small and well filled with grapes over-average in size. No wine was made. The must showed 26.6% of solid contents by spindle and 0.36% of acid.

No. 1604. *Grossblaue,* from Mission San José. Received October 28, 1891, in bad condition. The must showed 24.9% of solid contents by spindle and 0.36% of acid. The temperature of the grapes at crushing was 67°, and the maximum of 86° was reached on the second day. On the third day the murk was nearly dry, and was drawn off.

In one month the wine was clear, but still retained a little sugar. The lees were examined, and proved to be sound. At two months the wine was bright, full-flavored and full-bodied, but a little flat. The lees were examined again at three and at five months, but no bad germs were found. At ten months the wine was racked for the third time. At sixteen months it was in good order, had developed some bouquet, and was generally much improved. Part of it was bottled and the rest racked into a smaller keg. Six months later it had acquired a slight bitterness, but was otherwise a good wine. At twenty-two months the rest was bottled. Two years after bottling the wine was perfectly bright, without deposit—a very smooth, soft wine of Burgundy type, lacking in character, but very agreeable and of beautiful color.

No. 1682. *Grossblaue,* from Tulare station. A sample for must analysis was received September 21, 1892, in good condition. The must showed 24.8% of solid contents by spindle and 0.33% of acid.

No. 1751. *Grossblaue,* from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 22.6% of solid contents by spindle and 0.49% of acid.

No. 1768. *Grossblaue,* from Mission San José. Received October 15, 1892, in good condition. The must showed 20.0% of solid contents by spindle and 0.83% of acid. The temperature of the must at crushing was 58°, and the maximum reached was 88°, on the fifth day. On the seventh day the murk was drawn off, nearly dry.

A month from pressing the wine was clear, but still had a trace of sugar. It was racked, and two months later was bright, with little bouquet, but good flavor, clean taste, medium acid, astringency, and body. At five months it was in good order and of advanced development. At eight months it had been racked three times, and had developed some bouquet. After this it remained bright, and at fourteen months was a good wine, but lacking somewhat in flavor. At sixteen months it was mature, and was bottled. Eighteen months after bottling the wine was bright, without deposit—a light, somewhat greenish wine, of agreeable flavor and beautiful color.

No. 1829. *Grossblaue,* from Amador station. A sample for must analysis arrived September 8, 1893, in good condition. The bunches were small and somewhat coulured; the berries very unequal in size, well colored. The must showed 21.95% of solid contents by spindle and 0.95% of acid.

No. 1881. *Grossblaue,* from Paso Robles station. Received September 16, 1893, in good condition. The bunches were very varied, some small and loose, some large and more compact; the berries were large, well colored, and mature. The must showed 21.5% of solid contents by spindle and 0.76% of acid. The temperature of the must at crushing was 68°, and the maximum reached was 87°, on the third day. On the fifth day the murk was nearly dry, and was drawn off.

At one month the wine was clear, clean-tasting, and with high acid. After th second racking at four months it was bright, well flavored, but somewhat thin and the acid rather green. It improved after this, and developed some bouquet, but the acid continued somewhat raw. At eleven months the lees were examined, and they showed some *S. pastorianus.* At this time the wine was not mature, but of good quality. At eighteen months the wine was bright, improved, nearly mature, of fair bouquet and flavor. It was bottled a month later. Eleven months after bottling the wine was bright, of medium acid and astringency—a very good wine, but without marked character.

No. 1937. *Grossblaue,* from Tulare station. A sample for must analysis was received October 13, 1893, in good condition. The bunches were small, round, loose; the berries of good size, soft, and very sweet. The must showed 25.0% of solid contents by spindle and 0.49% of acid.

No. 2129. *Grossblaue*, from Cupertino. A sample for must analysis arrived November 5, 1893, in good condition. The bunches were of good size, conical, branching, and well filled; the berries of medium size, juicy, commencing to dry. The must showed 23.7% of solid contents by spindle and 0.82% of acid.

BLUE PORTUGUESE.

(See Vit. Rept. 1887–89, p. 242.)

The latest results obtained with the Blue Portuguese confirm the opinions expressed in the last report. It is a good grower, bears well, matures early, and preserves its soundness remarkably well; in the northern coast counties it makes a heavy-bodied wine, with good color and astringency, but low acid and consequent poor keeping qualities. The average composition of the must has been: at Mission San José, sugar 24.72% and acid 0.41%; at Cupertino, sugar 25.92% and acid 0.56%. At Tulare the vine is a good grower, shades its grapes well, and bears heavily, even in somewhat strong alkali soil. The defects of its wine, however, are increased there, and it loses most of the intensity of color that distinguishes it in other localities. The average composition of the musts analyzed at the station has been 22.5% of sugar and 0.40% of acid; but this includes some of imperfectly ripe grapes; the average acid content of ripe grapes is little over 0.30%. The wine is thus difficult to ferment, is flat-tasting, and of poor keeping qualities. It cannot, therefore, be recommended for Tulare County, in spite of its steady and abundant crops, for its lowness in acid is a fatal defect. The grapes may doubtless be advantageously used for blending with grapes of high acid, and tannin, and without detriment to their quality.

ANALYSES OF MUSTS AND WINES.

BLUE PORTUGUESE.		Date of Picking	MUST.				WINE.						
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body	Sugar
							By Weight	By Volume		At Pressing	At Six Months		
1890—No. 1206.	Fresno	Aug. 12	24.25	23.81	.38	.63	16.22	19.96*	.160	.48	.41	3.08*	2.02
No. 1262.	Mission San José	Sept. 24	24.35	------	.45	.33	9.63	12.00	.217	.48	.50	2.58	------
No. 1365.	Cupertino	Oct. 14	26.10	------	.39	------	------	------	------	------	------	------	------
No. 1399.	Cupertino	Oct. 18	27.60	------	.50	------	------	------	------	------	------	------	------
1891—No. 1440.	Tulare	Aug. 24	24.38	------	.30	------	------	------	------	------	------	------	------
No. 1511.	Mission San José	Sept. 24	24.35	------	.39	------	9.92	12.36	.327	.46	.42	3.35	------
1892—No. 1618.	Tulare	Aug. 28	24.35	22.20	.35	.50	9.20	11.45	.127	.32	.50	3.58	------
No. 1683.	Mission San José	Sept. 24	22.15	------	.55	------	8.84	11.00	.252	.48	.50	2.12	------
1893—No. 1813.	Tulare	Aug. 30	19.30	18.89	.57	.44	7.43	9.27	.202	.47	.41	2.95	------
No. 1815.	Tulare	Sept. 2	20.04	20.00	.50	.48	7.78	9.73	.134	.47	.47	3.00	------
No. 1985.	Mission San José	Oct. 17	27.40	27.25	.45	------	11.62	14.20	.400	.51	.47	3.30	------
No. 2038.	Cupertino	Oct. 29	23.50	------	1.05	------	------	------	.451	------	------	------	------
No. 2113.	Cupertino	Nov. 3	24.40	------	.56	------	------	------	.321	------	------	------	------
1894—No. 2137.	Tulare	Sept. 3	24.45	24.22	.29	.42	9.85	11.50	.229	.43	.57	4.35	------
No. 2256.	Mission San José	Oct. 5	23.70	------	.40	------	------	------	------	.38	------	------	------

* Fortified.

COLOR READINGS.

BLUE PORTUGUESE.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.		Six Months.	
1891—No. 1511.	Mission San José	95.2	1VR	71.4	1VR	55.5	2VR	55.5	2VR	44.9	3VR	37.0	5VR	------	
1892—No. 1618.	Tulare	16.6	R	16.0	1VR+Y	15.6	1VR+Y	14.2	1VR+Y	12.9	1VR+Y	12.9	1VR+Y	12.5	1VR+Y
No. 1683.	Mission San José	142.0	VR	54.1	1VR	43.5	1VR	42.1	1VR	41.6	1VR	40.0	1VR	------	
1893—No. 1813.	Tulare	21.1	3VR	9.3	2R	9.2	3R	9.5	3R	8.3	(Y)	8.3	(Y)	------	
No. 1815.	Tulare	18.8	4VR	11.2	5VR	7.6	4R	8.5	4R	------		------		------	
No. 1985.	Mission San José	100.0	VR	62.5	1VR	57.1	1VR	57.1	1-2VR	42.5	2VR	32.0	3VR	------	
No. 2038.	Cupertino	129.0	1VR	------		------		------		------		------		------	
No. 2113.	Cupertino	83.3	VR	------		------		------		------		------		------	
1894—No. 2137.	Tulare	27.0	2VR	25.5	4VR	23.9	5VR	16.5	R	------		------		------	
No. 2256.	Mission San José	72.8	1VR	------		------		------		------		------		------	

RECORD OF TREATMENT.

No. 1206. *Blue Portuguese*, from Fresno. Received August 14, 1890, in fair condition, and quite mature. The must showed 24.25% of solid contents by spindle and 0.38% of acid. The temperature of the must at crushing was 69°, and the maximum reached was 77°, on the fourth day. On the fifth day the fermentation was very slow, and the must showed 7.5% of solid contents by spindle; it was drawn off and fortified.

At four months the wine was bright, but harsh, unpleasing, and somewhat bitter. At this date it was racked and put into the hot-box, where it was kept at a temperature of 110° for three months. At two months after heating it was bright, dark-colored, of good bouquet, much improved in flavor, but still a little bitter. It was racked again, and at seventeen months after crushing was in good order, a fairly agreeable wine, but too acid and with very little Port character. At two years and a half it was smooth and clean-tasting, with some flavor, but too much acid. Four months later it had deteriorated.

No. 1262. *Blue Portuguese*, from Mission San José. Received September 26, 1890, in fair condition, and mature. The must showed 24.35% of solid contents by spindle and 0.45% of acid. The temperature of the must was 67° at starting, and 87° was the maximum, reached on the fourth day. On the fifth day the murk was nearly dry, and was drawn off.

The wine was slow in clearing and soon developed filaments in the lees. At two months it was clear, of low acid and good astringency, dark-colored, coarse and rough. At three months the wine was pasteurized; it was clear, but the taste was suspicious, and the lees showed a good many filiform germs. At seven months it was bright, with very little taste, due to improper fermentation; it had improved generally, and was a smooth, agreeable wine, but a little flat. After this it remained clear, but deteriorated in quality, and became tasteless and flat. It was racked twice, and at sixteen months put in bottle. Two years after bottling it was tasted and found to have changed very little; it had kept its color well, but was insipid.

No. 1365. *Blue Portuguese*, from Cupertino. A sample for must analysis was received October 17, 1890, in fair condition, a little dried and past maturity. The must showed 26.1% of solid contents by spindle and 0.39% of acid.

No. 1399. *Blue Portuguese*, from Cupertino. A sample for must analysis arrived October 21, 1890, in poor condition—shriveled, moldy, and overripe. The must showed 27.0% of solid contents by spindle and 0.50% of acid.

No. 1440. *Blue Portuguese*, from Tulare station. A sample for must analysis arrived August 27, 1891, in good condition. The must showed 24.38% of solid contents by spindle and 0.30% of acid.

No. 1511. *Blue Portuguese*, from Mission San José. Received September 27, 1891, in rather moldy and crushed condition. The must showed 24.35% of solid contents by spindle and 0.39% of acid. The temperature of the grapes at crushing was 67°, and the maximum of 91° was reached on the third day. The wine was nearly dry on the fourth day, when it was drawn off.

In one month the wine was quite clear and dry, very rough, and smelled a little moldy. A little later the lees showed a few filaments, and in a month the taste was beginning to be affected, so the wine was pasteurized. Four months after pasteurizing it had improved, was bright, very heavy-bodied, still coarse and flat. After this the wine was racked twice, and improved a little; at sixteen months it was a fair wine, and the unsound fermentation was quite arrested; it tasted a little flat, however. A few days later it was put in bottle.

No. 1618. *Blue Portuguese*, from Tulare station. Received September 1, 1892, in good condition. The must showed 24.35% of solid contents by spindle and 0.35% of acid. The temperature of the grapes at crushing was 68°, and the maximum, reached on the third day, was 93°. The wine was dry on the fifth day, when it was drawn off.

The wine was slow in clearing, and fermented for some time after pressing. At six weeks it was dry, and was pasteurized, as it tasted a little suspicious. At four months it was clear, but very inferior. At six months it was bright and improved, and would have been a fair wine but for a slight bitterness. From six to eleven months it was at its best, and changed very little. After that it deteriorated. At sixteen months it was bottled.

No. 1683. *Blue Portuguese*, from Mission San José. Received September 27, 1892, in good condition. The must showed 22.15% of solid contents by spindle and 0.55% of acid. The temperature of the grapes at crushing was 67°, and the maximum, reached on the third day, was 93°. The wine was dry on the fourth day, when it was racked off.

At three weeks, when it was racked and taken to the cellar, it was clear, but not very clean-tasting. At three months it was bright, with full bouquet and flavor, medium acid, good astringency—an agreeable wine, but lacking in after-taste. After this it remained in good order, and improved but never became quite clean-tasting. At eleven months it showed good quality, but had a disagreeable odor. It soon matured, and at eighteen months was bottled.

No. 1813. *Blue Portuguese*, from Tulare station. Received September 1, 1893, in fair condition, a little moldy. The bunches were of good size and without coulure; the berries of good size, thin-skinned, and with little flavor. The must showed 19.3% of solid contents by spindle and 0.57% of acid. The temperature of the grapes at crushing was 65°, and the maximum reached, on the sixth day, was 91°. On the seventh day the wine was drawn off, dry.

At one month the wine was clear, and at four months bright, but of poor quality. At ten months it had been racked twice, was clear, but flat, and with a disagreeable odor. It was little better than No. 1815.

No. 1815. *Blue Portuguese*, from Tulare station. Received September 4, 1893, in good condition. The must showed 20.04% of solid contents by spindle and 0.50% of acid. The temperature of the must at crushing was 67°, and the maximum, reached on the third day, was 100°. On the fourth day the wine was dry, and was racked off.

The wine was slow in clearing, and at one month was still cloudy and not clean-tasting. It was racked and taken to the cellar, and at five months, when it was racked for the second time, it was clear, but flat and of poor quality. After this, though it remained clear, it did not improve in quality, and at eleven months it was bright, but flat and poor.

No. 1985. *Blue Portuguese*, from Mission San José. Received October 19, 1893, in good condition, and very ripe. The bunches were rather large to medium, well filled, conico-cylindrical, with large shoulders, on very thick, woody peduncles; the berries were small, nearly round, thin-skinned, fleshy, and soft, very ripe, but very few dried. The must showed 27.4% of solid contents by spindle and 0.45% of acid. The temperature of the must at crushing was 59°, and the maximum, reached on the fifth day, was 85°. On the seventh day the wine was drawn off, though not quite dry.

At six weeks the wine was clear, but bitter. At three months it was bright, of good body, high astringency, medium acid, little bouquet, and some flavor; still a little bitter. At six months it had changed little, but had become a little flat. At nine months it showed some good qualities, but was not quite clean-tasting.

No. 2038. *Blue Portuguese*, from Cupertino. A sample for must analysis arrived October 31, 1893, in good condition. The bunches were over-medium in size, long conical, shouldered, close; the berries of medium size, round, much shriveled, and overripe. The must showed 23.5% of solid contents by spindle and 1.05% of acid.

No. 2113. *Blue Portuguese*, from Cupertino. A sample for must analysis arrived November 5, 1893, in good condition. The bunches were of medium size, long conico-cylindrical, close; the berries pulpy, very sweet, overripe, and commencing to shrivel, but without any raisin taste. The must showed 24.4% of solid contents by spindle and 0.56% of acid.

ZINFANDEL.

(See Vit. Rept. 1883–85, p. 96; 1885–86, p. 80; 1887–89, p. 230.)

Description.—Vine a vigorous grower, with grayish-brown wood; leaf dark green, lobed, with lighter green below, rather hairy or woolly, long; leaf-stem reddish, also long and wavy, young shoots slightly tomentose, tinged with red; bunches long and heavy, shouldered, often double or the shoulder as long as the main bunch, stem short and strong, brown, compact; berry medium, round, black with blue bloom and a peculiar star-like dot in the center, but often intermingled with small shriveled berries, ripening unevenly, very juicy, with a lively acid mingling with the sweet; skin thin. The vine is very productive, easy of cultivation, often producing a second and even a third crop from the laterals. Well adapted to short stool-pruning, and 3 to 4 feet stakes. (Prof. George Husmann.)

ANALYSES OF MUSTS AND WINES.

ZINFANDEL.	Date of Picking	MUST.				WINE.							
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body	Ash	Sugar
						By Weight	By Volume		At Pressing	At 6 to 8 Months			
1890—No. 1253. Fresno	Aug. 25	23.70	24.11	.54	.42	9.34	11.64	.199	.58	.45	2.78	.31	.22
No. 1253*a*. Fresno	------	------	------	------	------	9.20	11.45	.191	.59	.52	3.32	.55	.24
No. 1253*b*. Fresno	------	------	------	------	------	9.27	11.55	.199	.46	.48	3.08	.48	.22
No. 1257. Amador station	Sept. 23	22.60	------	.55	.29	10.35	12.82	.241	.54	.50	2.82	------	------
1892—No. 1656. Amador station	Sept. 16	23.73	------	.69	------	------	------	------	------	------	------	------	------

COLOR READINGS.

ZINFANDEL.	At Pressing.	One Month.	Two Months.	Three Months.	Four Months.	Five Months.
1890—No. 1253. Fresno	26.5 3VR	3.6 1VR+2Y	4.0 2VR+2Y	4.4 2VR+2Y	Too light for	instrument.
No. 1253*a*. Fresno	33.7 3VR	8.6 R	9.6 R	9.7 R	3.6 2VR+2Y	------
No. 1253*b*. Fresno	26.2 2VR	11.0 4VR	10.8 R	7.8 2R	3.6 2R+1Y	------
No. 1257. Amador station	37.0 4VR	14.7 5VR	12.7 5VR	10.0 R	10.0 R-1R	3.8 3VR+1Y
1892—No. 1656. Amador station	Too	light for instru	ment.			

RECORD OF TREATMENT.

No. 1257. *Zinfandel*, from Amador station. Received September 26, 1890, in poor condition; the grapes were badly crushed and some of them moldy. The bunches were of average size, compact, and shouldered; the berries small to medium, quite mature. The must showed 22.6% of solid contents by spindle and 0.55% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached, on the fourth day, was 77°. The fermentation was very slow, and the wine was still very sweet when it was drawn off on the sixth day.

At two weeks the wine was still very sweet and fermenting. At one month it was turbid, fermenting, and contained about 0.4% of sugar. At two months it was clear and dry, of fair color, low acid, high astringency, and strong, characteristic flavor. Two weeks later the lees showed some filaments under the microscope, and the wine was pasteurized at 160° F. At three months the lees appeared sound, and at seven months the wine was bright and had improved very much in smoothness. At eight months it was racked for the third time. At fourteen months it was in good order, full-flavored, nearly mature, and had developed some bouquet. At seventeen months it was racked and part put in bottle; six months later the rest was bottled. At three years and three months both samples were in first-class condition, with little bouquet, strong Zinfandel flavor, and clean taste. That bottled at seventeen months was more highly flavored and of deeper color, while that bottled at twenty-three months was smoother.

No. 1656. *Zinfandel*, from Amador station. A sample for must analysis was received September 19, 1892, in poor condition. The must showed 23.7% of solid contents by spindle and 0.69% of acid.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF AUSTRIAN AND HUNGARIAN TYPE—RED.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric.		Body
									At Pressing	At 6 to 8 Months	
	Kadarkas.										
1307	Cupertino	1890	21.30		.72	.27	10.36	.138	.62	.40	2.58
2042	Cupertino	1893	23.20		.57			.440			
1418	Mission San José	1890	25.85		.58	.28	12.82	.233	.62	.48	3.58
1787	Mission San José	1892	23.70		.68						
1986	Mission San José	1893	22.20	21.80	.68	.20	9.90	.371	.57	.54	3.10
2257	Mission San José	1894	20.85		.47			.149			
1461	Fresno	1891	23.70	23.13	.42						
	Average, Cupertino		**22.25**		**.64**	**.27**	**10.36**	**.289**	**.62**	**.40**	**2.58**
	Average, Mission San Jose		**23.15**	**21.80**	**.60**	**.24**	**11.36**	**.376**	**.59**	**.51**	**3.34**
	Grossblaue.										
1381	Mission San José	1890	25.10		.77	.27	12.54	.263	.62	.34	3.08
1604	Mission San José	1891	24.90	25.19	.54		12.73	.320	.45	.47	3.35
1768	Mission San José	1892	20.00	19.08	.83		10.42	.262	.77	.53	2.30
2253	Mission San José	1894	22.20		.68				.65		
1555	Paso Robles	1891	26.60		.36						
1751	Paso Robles	1892	22.60		.49						
1881	Paso Robles	1893	21.50	21.22	.76	.30	10.58	.182	.59	.59	3.20
1682	Tulare	1892	24.80		.33						
1937	Tulare	1893	25.00	24.64	.49	.43		.417			
2323	Tulare	1894	25.00		.46						
1829	Amador station	1893	21.95		.95			.451			
2285	Amador station	1894	25.45		.58						
2129	Cupertino	1893	23.70		.82			.249			
	Average, Mission San Jose		**23.10**	**23.13**	**.70**	**.27**	**11.89**	**.281**	**.62**	**.44**	**2.91**
	Average, Paso Robles		**23.56**	**21.22**	**.53**	**.30**	**10.58**	**.182**	**.59**	**.59**	**3.20**
	Average, Tulare		**24.93**	**24.64**	**.42**	**.43**		**.417**			
	Average, Amador station		**24.48**		**.70**			**.249**			

	Blue Portuguese.										
1206	Fresno	1890	24.25	23.81	.38	.63	*19.96	.160	.48	.41	*3.08
1262	Mission San José	1890	24.35	--------	.45	.33	12.00	.217	.48	.50	2.58
1511	Mission San José	1891	24.35	--------	.39	--------	12.36	.327	.46	.42	3.35
1683	Mission San José	1892	22.15	--------	.55	--------	11.00	.252	.48	.50	2.12
1985	Mission San José	1893	27.40	27.25	.45	--------	14.20	.400	.51	.47	3.30
2256	Mission San José	1894	23.70	--------	.40	--------	--------	--------	.38	--------	--------
1365	Cupertino	1890	26.10	--------	.39	--------	--------	--------	--------	--------	--------
1399	Cupertino	1890	27.60	--------	.50	--------	--------	--------	--------	--------	--------
2038	Cupertino	1893	23.50	--------	1.05	--------	--------	.451	--------	--------	--------
2113	Cupertino	1893	24.40	--------	.56	--------	--------	.321	--------	--------	--------
1440	Tulare	1891	24.38	--------	.30	--------	--------	--------	--------	--------	--------
1618	Tulare	1892	24.35	22.20	.35	.50	11.45	.127	.32	.50	3.58
1813	Tulare	1893	19.30	18.89	.57	.44	9.27	.202	.47	.41	2.95
1815	Tulare	1893	20.04	20.00	.50	.48	9.73	.134	.47	.47	3.00
2137	Tulare	1894	24.45	24.22	.29	.42	11 50	.229	.43	.57	4.35
	Average, Mission San Jose	--------	**24.39**	**27.25**	**.44**	**.33**	**12.39**	**.299**	**.46**	**.47**	**2.83**
	Average, Cupertino	--------	**25.40**	--------	--------	--------	--------	**.386**	--------	--------	--------
	Average, Tulare	--------	**22.50**	**21.32**	**.40**	**.46**	**10.48**	**.173**	**.42**	**.48**	**3.47**
	Zinfandel.										
1253	Fresno	1890	23.70	24.11	.54	.42	11.64	.199	.58	.45	2.78
1257	Amador station	1890	22.60	--------	.55	.29	12.82	.241	.54	.50	2.82
1656	Amador station	1892	23.73	--------	.69	--------	--------	--------	--------	--------	--------
	Average, Amador station	--------	**22.15**	--------	**.62**	**.29**	**12.82**	**.241**	**.54**	**.50**	**2.82**

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* Fortified.

B. WHITE-WINE GRAPES.

WHITE RHENISH TYPE.

The Rhenish grapes were among the first to be tried in California, and they have been tested, perhaps, more widely than any others. Very little wine, however, has been made in California that at all resembles the true Rhine wines. Many of our Riesling wines bear a much closer resemblance to Sauternes than to Rhine wines. This is to some extent due, as is generally understood by wine-growers, to the high percentage of sugar which the German grapes attain here at maturity. The problem, as generally understood, is to produce grapes which possess a moderate amount of sugar when perfectly ripe. The method of dilution with water before fermentation is, without doubt, incompatible with the production of the finest wines, but is probably less harmful to quality than is generally supposed, and if applied intelligently, and with a full knowledge and understanding of the conditions, will certainly result in much better wines than many California Rieslings.

Our failure to produce wines of the true Rhine-wine type is probably due more to the conditions of fermentation and treatment than to difference in must composition. Though most of the common German wines are very acid and of low alcoholic strength, the high-class wines are, in many cases, nearly or quite as high as our California Rieslings in alcohol, and no higher in acid. The slow, cool fermentation which the wines of Johannisberg and Steinberg undergo has doubtless much to do with their superior qualities. Our efforts, then, in California to produce similar wines should be directed toward temperature control and the elimination of injurious ferments.

JOHANNISBERG RIESLING.

(See Vit. Rept. 1885–86, p. 99.)

Synonyms: Weisser Riesling; Gentil aromatique.

Description.—Vine somewhat slender, with semi-erect canes; leaves of average size, thick, three or five lobed, petiolar sinus closed, upper surface dark green, glabrous and rugose, lower surface pale green and tomentose; bunch conico-cylindrical and compact; berries small, variable in size, spherical, punctate, sweet, and aromatic. The variety is easily distinguished from its less noble namesake, the Franken Riesling or Sylvaner, by its lobed and slightly pubescent, furzy leaves; it is also usually a slower grower and lighter bearer.

Of all the German varieties thus far tested in California, this is the one which has retained most of the qualities for which it is famous in its original district. This is true only of certain localities in California, where some good wines have been obtained from this variety, not, however, so delicate as the product of the Rhine district. It is a vigorous and fairly healthy vine, though it does not always set well at flowering, and is subject to *oidium;* it is, however, a rather poor bearer. It gives best results on a granitic or schist formation, and will not thrive on undrained soils. It ripens during the second period. It requires long-pruning, and the green canes should be tied up, as they are very brittle and easily broken by the wind. With long-pruning the crop has been about two and a half tons per acre at Cupertino, and with short-pruning almost nothing.

The best results are obtained with this variety in the coolest localities, in parts of the Santa Cruz Mountains for example. The average must composition at Cupertino has been 22.5% of sugar and 0.53% of acid, and about the same at Mission San José. This is somewhat lower in sugar and higher in acid than the other German varieties have shown. The Johannisberger is the most aromatic of the German grapes, with the exception of the Traminer, and is the best suited to producing a satisfactory wine without blending; it ferments well and is a good keeper.

TABLE OF PRODUCTION.

JOHANNISBERG RIESLING.	Number of Vines	Total Weight of Grapes, in lbs.	Average per Vine, in lbs.	Date of Picking
1887—No. 741 (short-pruned). J. T. Doyle, Cupertino	20	10	0.5	Oct. 14
No. 742 (long-pruned). J. T. Doyle, Cupertino	20	123	6.1	Oct. 14
1888—No. 874 (short-pruned). J. T. Doyle, Cupertino	19	35	1.8	Oct. 1
No. 875 (long-pruned). J. T. Doyle, Cupertino	14	75	5.3	Oct. 1
1889—No. 1139. J. T. Doyle, Cupertino	20	210	10.5	Oct. 2

ANALYSES OF MUSTS AND WINES.

JOHANNISBERG RIESLING.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at 6 to 8 Months	Volatile Acid	Body	Ash
1885—No. 461.* Gundlach & Co., by Dr. E. J. Fraser, San Francisco	------	------	------	------	------	9.92	12.36	.56	------	2.10	.21
1886—No. 487. J. T. Doyle, Cupertino	Sept. 23	20.40	18 48	.65	.27	7.78†	9.73	.60	------	1.80	------
No. 632.* J. Schramm, St. Helena	------	------	------	------	------	9.41	11.73	.56	------	2.10	.15
No. 652.* Captain Niebaum, Napa	------	------	------	------	------	9.56	11.91	.61	------	1.30	.37
No. 663.* H. W. Crabb, Oakville	------	------	------	------	------	10.07	12.50	.38	------	2.60	.23
No. 538. D. C. Feely, Patchen	Oct. 17	19.30	18.29	.36	.26	7.09†	8.85	.55	------	1.80	------
1887—No. 742 (long-pruned) J. T. Doyle, Cupertino	Oct. 14	21.24	20.24	.43	.40	8.84	11.00	.54	.09	2.30	------
No. 741 (short-pruned). J. T. Doyle, Cupertino	Oct. 14	23.49	------	.50	.36	Blen	ded	with	No.	761.	
1888—No. 862. J. Gallegos, Mission San José	Sept. 22	23.96	23.61	.46	.33	------	------	------	------	------	------
No. 874. J. T. Doyle, Expt. Plot, Cupertino	Oct. 1	22.05	23.13	.35	.31	8.98	11.18	.47	------	2.10	------
No. 875. J. T. Doyle, Expt. Plot, Cupertino	Oct. 1	22.40	22.67	.41	.29						
1889—No. 1068. John Gallegos, Mission San José	Sept. 9	21.95	21.38	.43	.31	8.48	10.58	.55	------	2.07	------
No. 1139. J. T. Doyle, Expt. Plot, Cupertino	Oct. 2	23.60	23.62	.60	.36	9.56	11.91	.52	------	1.57	------
1890—No. 1264. J. T. Doyle, Expt. Plot, Cupertino	Sept. 28	22.15	------	.66	.26	9.78	12.18	.42	------	2.40	------
1891—No. 1490. Paso Robles station	Sept. 9	24.55	------	.36	------	------	------	------	------	------	------
1892—No. 1777. Mission San José	Oct. 13	22.60	------	.62	------	------	------	------	------	------	------
1893—No. 1994. Mission San José	Oct. 18	22.20	------	.60	------	------	------	------	------	------	------
No. 2033. J. T. Doyle, Cupertino	Oct. 30	23.70	------	.65	------	------	------	------	------	------	------

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* Wines sent for examination.

† Analyses made in May, 1887.

Record of Treatment.

No. 741. *Johannisberg Riesling*, from J. T. Doyle, Cupertino. Received October 18, 1887, in good condition, and very ripe. The grapes were from short-pruned vines, and were very sweet and showed less coulure than those from long-pruned vines. The must showed 23.49% of solid contents by spindle and 0.50% of acid. The grapes were fermented with No. 742.

No. 742. *Johannisberg Riesling*, from J. T. Doyle, Cupertino. Received October 18, 1887, in good condition, but somewhat unevenly ripened. The bunches showed somewhat more coulure than those from the short-pruned vines, but it was not very bad in either case. The must showed 21.24% of solid contents by spindle and 0.43% of acid. The temperature of the grapes at crushing was 70°, and the maximum, reached on the third day, was 85°. On the seventh day the wine was dry, and on the sixteenth day it was drawn off the thick lees.

At two months the wine was bright and with good aroma, full body, low acid, and well-developed vinosity. A month later it was racked again, and at eight months it was in good condition, with strong aroma and full flavor, pleasant acid, and, in general, of high quality.

No. 862. *Johannisberg Riesling*, from J. Gallegos, Mission San José. A sample for must analysis was received September 25, 1888, in fair condition. The must showed 23.96% of solid contents by spindle and 0.46% of acid.

No. 874. *Johannisberg Riesling*, from J. T. Doyle, Cupertino. Received October 2, 1888, in fair condition; the grapes were crushed, and in some boxes fermentation had already commenced. The bunches were rather looser than normal and the berries were very uneven in size. The must showed 22.05% of solid contents by spindle and 0.35% of acid.

No. 875. *Johannisberg Riesling*, from J. T. Doyle, Cupertino. This sample was from short-pruned vines and differed little from those from long-pruned vines. The must showed 22.41% of solid contents by spindle and 0.40% of acid.

Nos. 874 and 875. The grapes were crushed the day they arrived, but were not pressed until the following morning. The temperature of the grapes at crushing was 74°, and the maximum reached, on the third day, was 79.5°. The wine was dry on the ninth day.

At one month the wine was racked and taken to the cellar. At three months it was clear, with good aroma, and well advanced. Two months later it was pasteurized, and at eight months, when it was racked for the third time, was in good condition and exhibited an extremely marked aroma and pleasing taste. At eleven months it was bright, clean-tasting, and of very high quality. At fourteen months it was nearly or quite mature, and showed a remarkable bouquet. Some wine put in glass at the last racking was bright, clean-tasting, and agreeable, but less pleasing and well developed than the wine in keg. At seventeen months it was racked again, and at eighteen was bottled. At twenty-nine months the wine bottled at nine months had deposited a heavy sediment; it was possessed of high aroma, but the flavor was not good. That bottled at eighteen months was bright and had made no deposit; it had less of the natural grape aroma, but was mature and good. At four years that first bottled had developed into a fine wine, with rich bouquet and agreeable acid. The wine bottled earlier had improved, and was bright, but inferior to the other.

No. 1068. *Johannisberg Riesling*, from J. Gallegos, Mission San José. Received September 12, 1889, in fair condition; the grapes were mature, but some of them were a little moldy. The must showed 21.95% of solid contents by spindle and 0.43% of acid. The temperature of the grapes at crushing was 72°, and the maximum, reached on the third day, was 79°. The wine was dry on the sixth day, when it was drawn off the thick lees.

At one month the wine was almost clear, and showed very good flavor and aroma. A month later it was quite clear and was racked and taken to the cellar. At three months the wine was bright, with marked and pleasing aroma, full, characteristic flavor, but with rather a suspicious after-taste. The wine improved for the next six or eight months, but after that became slightly pricked, and deteriorated.

No. 1139. *Johannisberg Riesling*, from J. T. Doyle, Cupertino. Received October 4, 1889, in good condition, and quite mature. The bunches were small; the berries small and unequal. The must showed 23.6% of solid contents by spindle and 0.60% of acid. The temperature of the grapes at crushing was 71°, and the maximum, reached on the third day, was 79°.

At two months the wine was clear, of very light color, strong and characteristic aroma, pleasing and marked flavor, clean taste, and in general very good. At this time it was racked and taken to the cellar. At four months it had improved and was quite sound. At seven months it retained its good quality, and was racked for the third time. A month later it was quite clear, but had a slightly suspicious taste, so it was pasteurized. Tastings at one and two months after pasteurizing showed that the wine remained sound; but the wine which was put in a demijohn became the brighter and developed a higher quality. A year later the wine was still bright and good, but after that it deteriorated.

No. 1264. *Johannisberg Riesling*, from J. T. Doyle, Cupertino. Received October 2, 1890, in fair condition and ripe, but not very sweet. The must showed 22.15% of solid contents by spindle. The fermentation lasted about eight days, reaching a maximum temperature of 81° on the fourth day.

At three weeks the wine was nearly clear; at seven weeks the lees showed a few filaments. At two months the wine was clear, with good flavor and aroma and full acid. At three months it was nearly bright, and had been racked twice; it had a high, agreeable bouquet and delicate flavor, clean taste and full acid. The lees showed a few lactic germs, but the taste was unaffected; it was pasteurized for safety. At seven months it was bright, of high quality and maturing well. At fourteen months it was clear, had full bouquet and flavor, but was slightly flat and not quite mature. At seventeen months it was racked for the fifth time and part of it bottled; the rest was bottled at twenty-five months. At twenty-seven months both wines were bright and of fair quality; that first bottled was not quite clean-tasting, while the second was a little exhausted.

No. 1490. *Johannisberger*, from Paso Robles station. A sample for must analysis arrived September 11, 1891, in good condition. The must showed 24.55% of solid contents by spindle.

No. 1777. *Johannisberger*, from Mission San José. A sample for must analysis was received October 15, 1892, in good condition. The must showed 22.6% of solid contents by spindle.

No 1994. *Johannisberger*, from Mission San José. A sample for must analysis was received October 19, 1893, in good condition. The bunches were small; the berries of medium size, highly flavored, and very ripe. The must showed 22.2% of solid contents by spindle.

No. 2033. *Johannisberger*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were of medium size, more or less compact; the berries of medium size, juicy, thin-skinned, with full acid and not quite mature. The must showed 23.7% of solid contents by spindle.

RED TRAMINER.

Synonyms: Savagnin Rose; Gentil Rose; Gewürz Traminer; Roth Edel.

Description.—Vine rather vigorous, with slender, spreading, short-jointed canes; leaves small, wider than long, three-lobed or without sinuses, nearly glabrous above and cobwebby below; bunches small, conical, close; berries small, nearly round, pink, juicy, sweet, and very aromatic.

The Traminer is one of the most widely ranging varieties of Europe, as the dozens of synonyms with which it is afflicted sufficiently attest. Under the name of Savagnin the white-fruited variation is common in eastern France, while the rose-fruited variation described above is common in many parts of Germany and Austria. The vine is not very productive, but gives a wine of very marked character, and the grapes are generally fermented with the Franken Riesling or other neutral grape. On account of its thick skin, which protects it from decay, it is often used for the manufacture of "vins de paille."

Where tested in California it has shown itself a shy bearer and requires long-pruning. It retains the high flavor which distinguishes it in Europe, and well maintains its character as the most aromatic of the German grapes. When mature, the grapes have, as in Europe, low acid, viz., 0.3% to 0.5%, but are much higher in sugar than is reported from there, viz., 24.0% to 28.0%. The wine is somewhat difficult to ferment and keep when used alone, but on account of its high aroma and high sugar content it makes an excellent blend with grapes of less flavor and more acid. At the Amador and Tulare stations it is a very shy bearer, and the grapes lose there most of their characteristic flavor. The grapes ripen a little later than the Ruländer and about the same time as the Johannisberger.

Analyses of Musts and Wines.

RED TRAMINER.	Date of Picking	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six to Eight Months	Body
						By Weight	By Volume		
1889—No. 1075. J. T. Doyle, Cupertino	Sept. 14	26.40	26.31	.41	.41	11.39	13.91	.50	2.65
1890—No. 1211. Margherita Vineyard, Fresno	Aug. 21	25.90	25.76	.52	.39	------	------	------	------
No. 1304. J. Gallegos, Mission San José	Oct. 5	25.10	------	.38	.39	10.35	12.82	.42	2.15
1891—No. 1542. Paso Robles	Oct. 4	23.70	------	.36	------	------	------	------	------
1893—No. 1810. Amador	Aug. 29	23.50	------	.50	------	------	------	------	------
No. 2017. Mission San José	Oct. 25	25.65	24.53	.38	.26	11.23	13.73	.38	3.10
No. 2099. J. T. Doyle, Cupertino	Nov. 5	28.30	------	.31	------	------	------	------	------

Record of Treatment.

No. 1075. *Red Traminer*, from J. T. Doyle, Cupertino. Received September 17, 1889, in fair condition, but somewhat crushed. The bunches were very unequal in shape, sometimes simply cylindrical and sometimes very much winged; the berries were small and slightly oval, with thick but tender skin, varying in color from greenish-yellow to pink. The fermentation was normal and complete.

At one month the wine was still a little cloudy, but was quite dry and of agreeable flavor. A week later it was nearly clear, showed good aroma, clean taste, and good flavor. At six weeks it was racked and taken to the cellar. At four months it was clear, of golden color, with very pronounced and characteristic aroma, full flavor, clean taste, and low acid. It was a wine of high quality, with full alcohol and body. Two months later it was racked again, and at eight months the lees were examined and found to contain a few acetic ferments. The taste was unaffected, however, and at nine months the wine was bright, clean-tasting, and well developed; it was a wine of very marked character and good development. At twelve months it was bright, well matured, and tasted perfectly sound, and very aromatic and full flavored. At this date it was racked for the third time. At eighteen months it was bright, but had suffered from being in such a small keg. It had lost somewhat in aroma, but was still of high quality and rich flavor. Wine bottled at twelve months was bright, sound, and equal to that in the keg, but had deposited some sediment. The wine was all bottled at eighteen months. A year later both bottlings showed many of the qualities of a fine wine, but also the effect of having been made in too small quantity.

No. 1211. *Red Traminer*, from Margherita Vineyard, Fresno. A sample for must analysis was received August 23, 1890, in poor condition, overripe. The must showed 25.9% of solid contents by spindle.

No. 1304. *Red Traminer*, from J. T. Doyle, Cupertino. Received October 8, 1890, in very good condition, all well colored and mature. The must showed 25.1% of solid contents by spindle. The fermentation lasted nine days, and was cool, reaching a maximum temperature of 76° on the third day.

At one month from crushing the wine was nearly clear, smooth, and with high aroma, but very raw. At three months the wine had been racked twice, but was not quite clear. The lees showed some lactic taint, which was also perceptible to the taste; the wine was therefore pasteurized. The wine was a long time clearing after being pasteurized, but it remained sound, and the lactic taint gradually disappeared. At the end of fifteen months it was clear and much improved, though somewhat flat. At seventeen months it was racked for the fifth time, and part of it put in bottle; the remainder was bottled at twenty-three months. At two years it was tasted, and neither sample found quite clear or clean-tasting; that first bottled had an extremely high and characteristic aroma, which was much less noticeable in that bottled later.

No. 1542. *Red Traminer*, from Paso Robles station. Received October 6, 1891, in good condition, mature, and highly flavored. The must showed 23.7% of solid contents by spindle. A sample for must analysis only was received.

No. 1810. *Red Traminer*, from Amador station. A sample for must analysis was received September 1, 1893, in good condition; the bunches were small, well filled, and without much of the characteristic flavor. The must showed 23.5% of solid contents by spindle.

No. 2017. *Red Traminer*, from Mission San José. Received October 26, 1893, in fair condition. The bunches were very small and well filled; the berries small, juicy, highly flavored, and very ripe. The must showed 25.65% of solid contents by spindle. The fermentation was very slow and cool, and the wine never became perfectly dry. This sample was fermented with 36% of Ruländer. (See No. 2018.)

At five weeks from crushing the wine was not clear and was very sweet. At three months it was bright and sound, but still slightly sweet, and possessed of a very high aroma. At four months it was racked for the third time. At seven months it was bright, a little sweet, and had acquired a slight bitter taste.

No. 2099. *Red Traminer*, from J. T. Doyle, Cupertino. A sample for must analysis was received November 6, 1893, in good condition. The bunches were of medium size, compact, with many abortive berries; the berries small to over-medium, thin-skinned, and very juicy, sweet, and mature. The must showed 28.3% of solid contents by spindle.

RULÄNDER.

Synonyms: Pinot gris; Auvernat gris.

Description.—Vine of moderate size and vigor; leaves of medium size, round, three-lobed, distinguished from those of the Pinot noir by their yellowish color; bunches small, close, cylindrical; berries round, juicy, of a light, dull gray-purple.

This variety is considered by most authors as a simple color variation of the ordinary Pinot noir, but the grapes are more highly flavored, and the vine more productive. It bears somewhat better than the Traminer and attains an equally high percentage of sugar. It is considered in Germany as one of the best grapes for the production of sparkling wines, and is valued there for the high percentage of sugar which it attains.

In California its sugar content ranges from 23% to 29%. A sample from Cupertino, allowed to remain too long on the vines, attained 31% of sugar with 0.48% of acid. In general, it shows more acid than the Traminer, varying from 0.4% to 0.6%. At the Amador station it has borne well, and the must averaged 25.5% of sugar and 0.53% of acid. Its flavor is marked and characteristic, though less so than that of the Traminer. It ripens a week or ten days earlier than the latter, and is equally difficult to ferment alone, requiring the addition of some lighter must, such as Franken Riesling.

ANALYSES OF MUSTS AND WINES.

RULÄNDER (OF EUROPE).	Date of Picking	MUST.				WINE.			
						Alcohol.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	By Weight	By Volume	Total Acid as Tartaric, at Six to Eight Months	Body
1890—No. 1217. Margherita Vineyard, Fresno	Aug. 23	25.20	24.64	.41	.31	------	-----	--- --	------
No. 1274. J. T. Doyle, Cupertino	Oct. 1	23.36	------	.55	.29	10.16	12.64	.36	2.28
No. 1315. J. Gallegos, Mission San José	Oct. 9	26.50	------	.45	.24	12.23	15.00	.36	2.44
1893—No. 1802. Amador	Aug. 29	25.00	------	.56	------	-----	------	------	------
No. 2018. J. Gallegos, Mission San José	Oct. 25	28.60	28.02	.50	.20	------	------	------	------
No. 2098. J. T. Doyle, Cupertino	Nov. 5	31.10	------	.48	------	------	------	-- --	------
1894—No. 2231. Mission San José	Oct. 2	25.35	------	.55	------	------	--- --	------	------
No. 2281. Amador	Oct. 4	24.35	------	.50	------	------	------	------	------

RECORD OF TREATMENT.

No. 1217. *Ruländer*, from Margherita Vineyard, Fresno. A sample for must analysis was received August 25, 1890, in fair condition; overripe and somewhat crushed. The must showed 25.2% of solid contents by spindle.

No. 1274. *Ruländer*, from J. T. Doyle, Cupertino. Received October 2, 1890, in fair condition, somewhat bruised and with a few moldy berries; the bunches and berries were both small. The must showed 23.36% of solid contents by spindle. The fermentation was cool, and lasted over a week; the maximum temperature reached was 79°, on the fourth day.

The wine was nearly clear in three weeks, and quite clear in six. At two months it was a rich, generous wine, of marked flavor and aroma, medium acid, and good body and alcohol. After the third racking at six months it was bright, good, and sound, but had lost much of its striking aroma. At fourteen months it had lost still more of its distinctive character, but was still bright and sound. Some of the wine was bottled at fifteen and some at twenty-one months. At twenty-six months both wines were tasted, but neither of them had kept well; the second bottled was the best.

No. 1315. *Ruländer*, from Mission San José. Received October 10, 1890, in very bad condition—moldy and bruised. The must showed 26.5% of solid contents by spindle. The fermentation lasted a week, and attained its maximum temperature of 79° on the fourth day.

At one month the wine was clear, and showed a full and agreeable flavor, some aroma, low acid, and full body. At three months it was pasteurized, the lees showing lactic rods and the taste becoming affected. At seven months the slight lactic taste had disappeared, but the wine was a little flat. At fourteen months the wine was clear, with good bouquet and flavor, but with a slight bitter taste. At sixteen months the wine was bottled, having been racked five times. At twenty-seven months the bottled wine was not quite clear or clean-tasting, but had a full, rich flavor.

No. 1802. *Ruländer*, from Amador station. A sample for must analysis was received September 1, 1893, in good condition; the bunches were small, but well filled. The must showed 25.0% of solid contents by spindle.

No. 2018. *Ruländer*, from Mission San José. Received October 26, 1893, in fair condition. The bunches were very small and close; the berries small, juicy, thin-skinned, and of a dull purple-gray. The grapes were mature, and the must showed 28.6% of solid contents by spindle. This sample was fermented with No. 2017, Gewürz Traminer, from Mission San José.

No. 2098. *Ruländer*, from J. T. Doyle, Cupertino. A sample for must analysis arrived November 6, 1893, in good condition. The bunches were small, compact, with thick peduncles; the berries small, juicy, soft, shriveled, and overripe. The must showed 31.1% of solid contents by spindle.

FRANKEN RIESLING.

(See Vit. Rept, 1885–86, p. 98.)

Synonyms: Sylvaner blanc; Plant du Rhin.

The Franken Riesling is chiefly grown in the Austrian empire, but also on the Rhine, and in Alsace and France, where it bears the name of *Plant du Rhin*, *Auxerrois*, and many others. It is, therefore, a widely spread variety, and is especially adapted to the cooler and more exposed locations and poorer soils, where other vines would yield but an indifferent product. As its wine is rich in gummy ingredients, it is customary to ferment it with other good varieties, such as the true Riesling, Traminer, etc., in order to prevent its passing into the mucous fermentation. For the same reason, it is desirable to aërate the must before fermentation. The vine is easily recognized by its light green, round leaf, which is scarcely lobed.

Description.—Vine strong-growing and productive, with thick, erect, and somewhat short-jointed canes; leaves of medium size, round, puffy, entire or with two shallow lateral sinuses closed by the overlapping of the lobes, almost glabrous on both sides, teeth short and unequal; bunches of medium size, cylindrical or slightly conical, compact, on short, thick peduncles; berries of medium size, round or deformed by pressure, firm, thick-skinned, punctate.

This variety has been rather extensively planted in California, and in some places has given good results. As distributed in this State it is often mixed with a large-leaved, very vigorous-growing variety, which nearly always loses its crop by coulure. The true Franken Riesling is a vigorous grower, with ample foliage, and, when long-pruned, a fair bearer. At Cupertino, with long-pruning, it has yielded an average of four and a half tons per acre, and with short-pruning only one tenth of that amount. Like most of the German varieties in California, it attains a higher percentage of sugar than in Germany; in acid, it generally runs higher than the Traminer and lower than the Johannisberger—about the same as the Zierfahndler.

Its average composition has been: at Cupertino, 23.6% of sugar and 0.43% of acid; at Mission San José, 21.1% of sugar and 0.48% of acid; at Paso Robles, 23.0% of sugar and 0.46% of acid. The must is somewhat difficult to ferment and slow in clearing, and it gives a wine of full flavor, though much less marked than that of the Johannisberger, but requires the addition of some better fermenter to produce the best results. In its native habitat it is usually associated with the true Riesling, the Traminer, and the Elbling.

TABLE OF PRODUCTION.

FRANKEN RIESLING.	Number of Vines	Total Weight of Grapes, in lbs.	Average per Vine, in lbs.	Date of Picking
1887—No. 699 (long-pruned). J. T. Doyle, Cupertino	20	166	8.3	Oct. 5
No. 713 (short-pruned). J. T. Doyle, Cupertino	20	20	1.0	Oct. 10
1888—No. 897 (long-pruned). J. T. Doyle, Cupertino	8	148	18.5	Oct. 9
No. 898 (short-pruned). J. T. Doyle, Cupertino	20	30	1.5	Oct. 9
1889—No. 1129. J. T. Doyle, Cupertino	20	250	12.5	Oct. 1

Analyses of Musts and Wines.

FRANKEN RIESLING.	Date of Picking	MUST.				WINE.						
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at 6 to 8 Months	Volatile Acid	Body	Ash	Sugar
						By Weight	By Volume					
1883—No. 94. Charles Krug, St. Helena		20.16	20.24	.52	.42	9.02	11.22	.38		1.57	.29	
1885—No. 342. J. Gallegos, Mission San José		21.47		.56	.39	8.48	10.58	.60	.37	3.82	.27	.65
No. 365. D. C. Feely, Patchen		21.16		.45	.32	9.05	11.27	.35		1.80	.16	
1886—No. 474. J. Gallegos, Mission San José	Sept. 10	19.70		.59	.33							
No. 491. J. T. Doyle, Cupertino	Sept. 21	18.60	18.58	.51	.27	7.09	8.85	.56		1.80		
1887—No. 699 (long-pruned). J. T. Doyle, Cupertino	Oct. 5	23.83	24.01	.45	.40	10.26	12.73	.60	.09	2.30		
No. 713 (short-pruned). J. T. Doyle, Cupertino	Oct. 10	26.06	26.12	.40	.46							
1888—No. 885. J. Gallegos, Mission San José	Oct. 2	22.15	21.96	.30	.35	7.64	9.54	.60		1.80		
No. 897 (long-pruned). J. T. Doyle, Cupertino	Oct. 9	24.36	25.19	.32	.37	10.07	12.54	.55		2.00		
No. 898 (short-pruned). J. T. Doyle, Cupertino	Oct. 9	23.56	23.81	.31	.38							
No. 929 (Riesling). W. G. Klee, Santa Cruz	Oct. 22	20.29	20.24	1.08	.25	8.20	10.25	.68		2.70		
1889—No. 1129. J. T. Doyle, Cupertino	Oct. 1	25.10	24.97	.48	.31	10.26	12.73	.33		2.05		
1890—No. 1273. J. T. Doyle, Cupertino	Sept. 29	21.92		.50	.24	8.91	11.09	.33		1.80		
1891—No. 1494. Paso Robles	Sept. 13	20.40		.48								
No. 1501. Asti, Sonoma County	Sept. 22	24.40	23.90	.50	.40	9.92	12.36	.38		2.05		
1892—No. 1642. Paso Robles	Sept. 13	23.70		.48								
No. 1734. Paso Robles	Oct. 11	25.90		.32								
1893—No. 1805. Amador station	Aug. 29	21.70		.64								
No. 1883. Paso Robles	Sept. 19	21.50	20.24	.55	.32	7.09	8.85	.50		1.80		
No. 2035. J. T. Doyle, Cupertino	Oct. 30	25.45		.46								
1894—No. 2284. Amador station	Oct. 4	26.30		.51								

RECORD OF TREATMENT.

No. 699. *Franken Riesling*, from J. T. Doyle, Cupertino. Received October 6, 1887, in good condition. The grapes were from long-pruned vines. The bunches were of fair size, the berries large and characteristically spotted. There were very few dried berries and very little coulure. The must showed 23.83% of solid contents by spindle and 0.45% of acid. The temperature of the grapes at crushing was 70°; and the maximum, reached on the third day, was 87°. The fermentation was over on the fourth day. During the fermentation the wine was thoroughly aërated once a day.

At two weeks the wine was drawn off the thick lees, and at two months it was bright, showed good Riesling aroma, and medium acid. Three weeks later the microscope showed the lees to be unsound, so the wine was racked off and pasteurized. The wine after this improved and remained clear for four or five months, after which it deteriorated.

No. 713. *Franken Riesling*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 14, 1887, in excellent condition. The grapes were from short-pruned vines. The bunches were loose and showed a considerable amount of coulure; the berries were of extra size, with the exception of a few abortive ones, and there were fewer dried and shriveled berries than in the long-pruned sample. The must showed 26.06% of solid contents by spindle and 0.40% of acid.

No. 885. *Franken Riesling*, from J. Gallegos, Mission San José. Received October 5, 1888, in fair condition. The bunches were cylindrical and compact, the berries large. The must showed 22.15% of solid contents by spindle and 0.30% of acid. The temperature of the grapes at crushing was 67.5°, and the maximum, reached on the third day, was 80°. The fermentation was over on the tenth day, and the wine was drawn off the thick lees.

At one month the wine was racked and taken to the cellar. At three months it was nearly clear, with marked and very pleasant aroma. Two months later the wine was pasteurized, as the lees showed unsound ferments. At eight months, when the wine was racked for the third time, it was in good order and of pleasing flavor, but little bouquet. Two months later it was in good order, pleasing, clean-tasting, and of fair quality, but lacking in bouquet. After this the wine improved, developed some bouquet, and was at its best at about sixteen months.

No. 897. *Franken Riesling*, from J. T. Doyle, Cupertino. Received October 10, 1888, in good condition and fully ripe. The bunches, which were typical, showed very little coulure, but some dried grapes. The must showed 24.36% of solid contents by spindle and 0.32% of acid. The grapes, which were from long-pruned vines, were mixed with No. 898, the same variety from short-pruned vines, and fermented, as shown in the record given below.

No. 898. *Franken Riesling*, from J. T. Doyle, Cupertino. Received October 10, 1888, in good condition. The grapes, which were from short-pruned vines, showed more coulure than the sample from long-pruned vines. The must showed 23.56% of solid contents by spindle and 0.31% of acid. The temperature of the grapes at crushing was 76°, and the maximum, reached on the third day, was 85°. Mixed with No. 897 and fermented, with the following record:

Nos. 897 and 898. At three weeks the wine was racked and taken to the cellar. At three months it showed high quality. Two months later it was pasteurized. At ten months it was clear, rather too yellow in color, with marked and agreeable flavor and bouquet, good body, acid, and alcohol. Three months later it was still very good, but slightly pricked. It remained good until the age of sixteen months, after which it deteriorated, on account of the smallness of the sample.

No. 929. *Riesling*, from W. G. Klee, Glenwood, Santa Cruz County. Received October 24, 1888, in good condition. The bunches were small and loose; the berries small, round, and spotted. The grapes showed a little coulure. The must showed 20.29% of solid contents by spindle and 1.08% of acid. The temperature of the grapes at crushing was 70°, and the maximum, reached on the fourth day, was 81°. The must fermented slowly, and at three weeks it was nearly through and was racked off.

At one month the wine was taken to the cellar. At three months the wine tasted green and did not show much aroma; at this time it was pasteurized. At six months the wine was racked for the third time, and at ten months it was in good condition, of light golden color, clean taste, pleasing flavor, and full acid; it had developed a good bouquet. At fourteen months it tasted nearly mature. At sixteen months the wine was very good, and tasted mature, was rather light, and had very full acid; in general, it was very agreeable, and a good imitation of a Rhine wine. Five months later the wine retained its good quality. At two years it was bottled. At twenty-seven months the bottled wine was clear and agreeable, but rather thin. Some wine which had been bottled at six months and rebottled at seventeen months showed more character of flavor and aroma, but was not quite clean-tasting. Eighteen months later both wines were good, but the second bottling was the better.

No. 1129. *Franken Riesling*, from J. T. Doyle, Cupertino. Received October 3, 1889, in very good condition, and completely mature. The bunches varied in size and compactness; the berries were of unequal size, but generally above the average. The must showed 25.1% of solid contents by spindle and 0.48% of acid. The temperature of the grapes at crushing was 70°, and the maximum reached was 85°, on the second day. The wine was dry on the fifth day, when it was drawn off the thick lees.

At seven weeks the wine was nearly clear, of very light color, smooth, and agreeable; it was racked and taken to the cellar. At three months it was in good condition, without marked flavor or aroma, but agreeable, solid, and sound. At seven months it was racked for the third time, and was bright and sound. At fifteen months it was perfectly bright and sound, had developed a good bouquet, and tasted very clean and mature. Two months later it was bottled in part, and at twenty-two months the rest was bottled. At twenty-nine months the wine bottled at seven and that bottled at twenty-two months had deteriorated, but that bottled at seventeen months was very good. One year later the last wine was little changed, but was good, though lacking in bouquet.

No. 1273. *Franken Riesling*, from J. T. Doyle, Cupertino. Received October 2, 1890, in fair condition, a few rotten and moldy bunches; grapes of fair size, and mature. The must showed 21.92% of solid contents by spindle. The fermentation lasted seven days, reaching the maximum temperature of 80° on the fourth day.

The wine cleared slowly, and fermented gently for several weeks. At two months from crushing it had been racked twice, but was not quite clear; it was smooth, with good body and moderate acid. At three months it was racked again, but was not perfectly clear. At five months the lees showed a few lactic filaments, but the taste was unaffected; it was pasteurized for safety. Even after pasteurizing it was slow in clearing, and remained flat and insipid for some time. At fourteen months the taste had improved slightly, but the wine was not quite clear and had no bouquet. At sixteen months the wine was bottled. At twenty-seven months the bottled wine was bright, but flat and exhausted.

No. 1494. *Franken Riesling*, from Paso Robles station. A sample for must analysis was received September 16, 1891, in good condition, and mature. The must showed 20.4% of solid contents by spindle.

No. 1501. *Franken Riesling*, from Asti, Sonoma County. Received September 25, 1891, in good condition. The must showed 24.4% of solid contents by spindle. The fermentation was cool and prolonged, reaching a maximum temperature of 79° on the third day, and lasting over ten days.

At one month the wine was quite dry, but still cloudy. At two months it was nearly clear and full flavored. At three months it was racked for the third time, being clear, but still very raw and undeveloped. At five months it was bright and much improved, was smooth and pleasing, with full bouquet and flavor. At sixteen months it was bottled, being still a good wine, but with a somewhat suspicious after-taste.

No. 1642. *Franken Riesling*, from Paso Robles station. A sample for must analysis was received September 16, 1892, in good condition. The must showed 23.7% of solid contents by spindle.

No. 1734. *Franken Riesling*, from Paso Robles station. A sample for must analysis arrived October 13, 1892, in good condition. The must showed 25.9% of solid contents by spindle.

No. 1805. *Franken Riesling*, from Amador station. A sample for must analysis arrived September 1, 1893, in good condition. The bunches and berries were small and fairly well flavored; a few grapes were sunburned. The must showed 21.7% of solid contents by spindle.

No. 1883. *Franken Riesling*, from Paso Robles station. Received September 21, 1893, in good condition. The bunches were small and compact; berries of medium size, soft, and with little flavor. The grapes were mature, but not very sweet. The must showed 21.5% of solid contents by spindle. The fermentation lasted eight days, reaching its maximum temperature of 78° on the second day.

In three weeks the wine was clear, and was racked for the second time. At four months the wine was bright, of good bouquet and flavor, and generally a very smooth and agreeable wine. At eight months it had been racked three times; it was very good, and showed signs of maturing quickly.

No. 2035. *Franken Riesling*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were compact and under medium size; the berries over medium size, pulpy, with good, but not high flavor; the grapes were mature. The must showed 25.45% of solid contents by spindle.

ORLEANS.

Synonyms: Orleaner; Gros Riesling; Orleans Riesling.

Description.—Vine fairly vigorous when grown on suitable soil; leaves of medium size, longer than wide, glabrous on both surfaces, except for some rough hairs on the nerves below, three to five lobed, the upper sinuses very deep, the lower scarcely marked; bunches of medium size, conico-cylindrical, somewhat close; berries over average size, slightly ovoid, juicy, but with firm flesh and rather thick skin; without special aroma; ripening in the second epoch, a week or two after the Riesling.

This variety is grown throughout the Palatinate and the Rhingau, but above all at Rudesheim, where it makes wines which are only second to those of the true Rieslings in celebrity. It is one of the most anciently known grapes of Germany, but has been very generally replaced by the Johannisberger. It is, in general, a better bearer than the true Rieslings, and does not require long-pruning.

At the Amador station it has shown itself to be a moderate grower, with upright canes, and a good, regular bearer. It succeeds there better in a granite soil, with a northern exposure, than in a warmer red soil. At Tulare, in an alkali soil, it is a poor grower, and though it shades its grapes well and produces good-sized, well-filled bunches, the crop is small and the must is very deficient in acid.

ANALYSES OF MUSTS.

	Date of Picking.	Solid Contents by Spindle.	Acid as Tartaric.
1893—No. 2031. Cupertino	Oct. 29	26.50	.54
1894—No. 2141. Amador station	Sept. 11	26.50	.47
No. 2311. Tulare	Oct. 11	24.90	.24

KLEINBERGER.

(See Vit. Rept. 1885–86, p. 95.)

Synonyms: Weisser Elbling; Putzscheer; Gouais blanc.

Description.—Vine strong-growing and durable, with rough bark; leaves large, coarse, slightly or not at all lobed, round, dark green above, a little woolly below; bunches of medium size, conical, compact or often loose, and with many small, abortive berries; berries over medium size, thin-skinned, very juicy, without special flavor, and ripen about the third period.

This is one of the most widely distributed varieties in the northern and central wine-growing districts of Europe, and owes its popularity principally to its heavy-bearing qualities. It is the true white Burger of Germany, and has, in some respects, given more satisfaction here than the California Burger. It bears less here and requires long-pruning, but gives a wine of higher quality.

At Cupertino the average crop of long-pruned vines has been 5 tons per acre, and of short-pruned vines only 1.7 tons. In Tulare the crop has been light for the locality, viz., 3.6 tons; at the Amador station it has proved a fair bearer.

In Germany the grapes attain but a very low percentage of sugar with very high acid, but here they generally develop more sugar and less acid than the Burger. In the central coast counties it ranges from 22% to 26% of sugar and 0.45% to 0.60% of acid. At Tulare it has averaged 24% of sugar and 0.48% of acid; at the Amador station it goes even higher in sugar, with an equal amount of acid.

The best results with this variety have been obtained at Mission San José, where it makes a good, clean wine, without much character, but fermenting easily, maturing early, and developing some bouquet. At Tulare it makes a fair wine, but no better than others which produce larger crops.

One of its greatest defects is the thinness of the skin of the grape, which renders it very susceptible to damage from bad weather or rough handling.

TABLE OF PRODUCTION.

KLEINBERGER.	Number of Vines	Total Weight of Grapes, in lbs.	Average per Vine, in lbs.	Date of Picking
1887—No. 715 (long-pruned). J. T. Doyle, Cupertino	20	110	5.5	Oct. 11
No. 764 (short-pruned). J. T. Doyle, Cupertino	20	20	1.0	Oct. 20
1888—No. 865 (short-pruned). J. T. Doyle, Cupertino	19	153	8.0	Sept. 26
No. 866 (long-pruned). J. T. Doyle, Cupertino	20	440	22.0	Sept. 26
1889—No. 1106. J. T. Doyle, Cupertino	20	320	16.0	Sept. 25

ANALYSES OF MUSTS AND WINES.

KLEINBERGER.	Date of Picking	MUST.				WINE.				
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at 6 to 8 Month	Body	Ash
						By Weight	By Volume			
1886—No. 488. J. T. Doyle, Cupertino	Sept. 21	17.60	17.22	.49	.25	6.75	8.46	.47	1.80	------
1887—No. 715 (long-pruned). J. T. Doyle, Cupertino	Oct. 11	23.40	23.61	.42	.42	9.70	12.09	.39	2.60	------
No. 764 (short-pruned). J. T. Doyle, Cupertino	Oct. 18	24.70	------	.52	------	Blended with No. 761.				
1888—No. 865 (short-pruned). J. T. Doyle, Cupertino	Sept. 26	22.69	23.13	.46	.36	8.70	10.83	.46	2·60	------
No. 866 (long-pruned). J. T. Doyle, Cupertino	Sept. 26	21.35	21.14	.44	.36	8.34	10.42	.52	2.05	------
1889—No. 1088. J. Gallegos, Mission San José	Sept. 17	23.70	24.12	.55	.38	9.63	12.00	.53	2.85	------
No. 1106. J. T. Doyle, Cupertino	Sept. 26	23.90	24.12	.45	.36	9.92	12.36	.53	2.50	------
1890—No. 1222. Margherita Vineyard, Fresno	Aug. 22	23.05	23.13	.54	.33	------	------	------	------	------
No. 1282. J. T. Doyle, Cupertino	Oct. 1	20.60	------	.50	.31	8.84	11.00	.40	2.32	------
No. 1299. J. Gallegos, Mission San José	Oct. 4	23.70	------	.60	------	------	------	------	------	------
1891—No. 1578. Mission San José	Oct. 13	26.50	24.96	.50	.36	10.35	12.82	.49	2.55	------
1892—No. 1645. Paso Robles	Sept. 13	21.50	------	.69	------	------	------	------	------	------
No. 1712. Mission San José	Oct. 3	24.35	24.20	.63	.33	8.70	10.83	.79	2.85	------
1893—No. 1880. Paso Robles	Sept. 14	19.50	18.58	.59	.30	7.23	9.00	.60	2.10	------
No. 1981. Tulare	Oct. 16	24.35	23.21	.50	.50	9.20	11.45	.57	3.10	------
No. 1990. Mission San José	Oct. 18	23.50	22.67	.63	------	9.05	11.27	.62	2.20	------
No. 2100. J. T. Doyle, Cupertino	Nov. 4	25.90	------	.53	------	------	------	------	------	------
1894—No. 2144. Amador station	Sept. 11	27.10	------	.47	------	------	------	------	------	------
No. 2242. Mission San José	Oct. 3	23.90	------	.45	------	------	------	------	------	------
No. 2341. Tulare	Oct. 17	24.80	------	.39	------	------	------	------	------	------

RECORD OF TREATMENT.

No. 715. *Kleinberger*, from J. T. Doyle, Cupertino. Received October 12, 1887, in fair condition, somewhat crushed. The grapes were crushed the day they arrived, and the must showed 23.4% of solid contents by spindle and 0.42% of acid. The grapes were from long-pruned vines. The normal berries were large, but were mixed with a great many small ones, showing late coulure to the extent of about 50%; they were very sweet, juicy, and with little acid, and some were dried up. The temperature of the grapes at crushing was 70°, and the maximum reached was 78°, on the third day. On the eighth day the wine was dry.

On the eighteenth day the wine was drawn off the thick lees. At two months it was bright, with good aroma, medium acid, and light body, altogether a good, well-flavored wine. A month later it was racked again. At eight months the wine had not improved; it was clear, but had a suspicious taste. A microscopic examination of the lees showed the presence of filaments, so the wine was racked and pasteurized, but did not improve afterward.

No. 764. *Kleinberger*, from J. T. Doyle, Cupertino. Received October 20, 1887, in fair condition, and crushed the following day. The bunches were nearly all very small, and the berries very uneven in size and degree of ripeness; some grapes were very large and many were small and abortive, some were overripe, and some underripe and very green and acid. The must showed 24.7% of solid contents by spindle and 0.52% of acid. The must was blended with No. 761.

No. 865. *Kleinberger*, from J. T. Doyle, Cupertino. Received September 28, 1888, in good condition. The grapes were from short-pruned vines. The bunches were well filled and the grapes ripe. The must showed 22.69% of solid contents by spindle and 0.46% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 83°, on the third day. The wine was drawn off the heavy lees on the seventh day, though it was still fermenting a little.

No. 866. *Kleinberger*, from J. T. Doyle, Cupertino. Received September 28, 1888, in fair condition, and mature. The grapes were from long-pruned vines; they were crushed the day they arrived. The bunches were very uneven as regards form and size, and showed some late coulure; the berries varied much as to size and degree of ripeness. The must showed 21.35% of solid contents by spindle and 0.44% of acid. The temperature of the grapes at crushing was 67°, and the maximum reached was 84°, on the third day. The wine was drawn off the heavy lees on the eighth day, though still fermenting very slowly.

At one month the wine was racked again and taken to the cellar. At three months it was still cloudy, but tasted agreeable; it was better than No. 865, and gave promise of being a good blending wine. Two months later it was racked again and the lees examined. A month later it was not quite clear, but had developed some bouquet. At eleven months it was clear but not bright, very light colored, with marked bouquet and pleasing flavor, clean-tasting, and in general good. Four months later some wine which had been kept in a demijohn was tasted, and found to be almost as good as that in the keg, but not quite clean-tasting. At seventeen months it was bright, fresh, and clean-tasting, much better than No. 865, which had deteriorated, owing, doubtless, to the small size of the keg in which the latter was kept. At this date it was racked again, and four months later a microscopic examination of the lees showed them to be quite sound. At this date the wine was in good condition, and was of fairly good quality, with good bouquet.

No. 1088. *Kleinberger*, from J. Gallegos, Mission San José. Received September 19, 1889, in rather poor condition, and crushed the same day. The bunches were of medium size, cylindrical, and close; the berries large but unequal, round, with thin and tender skin, soft, juicy, and mature. The must showed 23.7% of solid contents by spindle and 0.55% of acid. The temperature of the grapes at crushing was 72°, and the maximum reached was 83°, on the third day. The wine was quite dry on the sixth day, and was drawn off the thick lees.

At one month the wine was nearly clear and showed some aroma, but was not very agreeable to the taste. At six weeks it was racked and taken to the cellar. At four months an examination of the lees showed them to be sound. At six months the wine was racked again, and at nine months it was bright and of fair quality, of good flavor, but lacking in bouquet, and not quite clean-tasting. Later, the wine deteriorated.

No. 1106. *Kleinberger*, from J. T. Doyle, Cupertino. Received September 27, 1889, in good condition, but rather overripe. The grapes agreed with Pulliat's description, but were rather irregular. The must showed 23.9% of solid contents by spindle and 0.45% of acid. The temperature of the must at crushing was 65°. The must was fermented in a keg surrounded by a jacket of water, which was kept at a temperature of 65°. The maximum temperature reached by the must was 70°, on the fourth day. On the fourth day the wine was transferred to another keg and put in the cellar.

At three weeks the wine was racked. At five weeks it was bright, of very light greenish color, of faint but agreeable bouquet, neutral flavor, and clean taste. At two months it was racked again. At four months it was in good condition, somewhat deeper in color than at last tasting, of good quality. The lees were examined at four and at eight months, and found to be sound. At eight months the wine was racked again, and at nine months it was clear, with pleasing bouquet and flavor, agreeable acid, and in general a good wine. At eleven months is was racked again; it was still good, but had a slight taste of mold. At sixteen months it was bright, with little bouquet, good flavor, body, and alcohol. At seventeen months the wine bottled at nine months was bright and equal to that in the keg, but had a little more of the moldy taste. At this date the wine was all bottled. A year later the wine first bottled showed that but for the moldy taste it would have been an excellent light wine of neutral character. The wine bottled later was cleaner-tasting and very drinkable, though with little character.

No. 1222. *Kleinberger*, from Margherita Vineyard, Fresno. A sample for must analysis arrived August 23, 1890, in fairly good condition, slightly overripe. The must showed 23.05% of solid contents by spindle.

No. 1282. *Kleinberger*, from J. T. Doyle, Cupertino. Received October 3, 1890, in very bad condition, many grapes moldy and rotten. The must showed 20.6% of solid contents by spindle. The fermentation was slow, and lasted about twelve days; it reached its maximum temperature of 82° on the third day.

Three weeks after crushing the wine was nearly clear, but had a moldy taste. At two months it was clear and the moldy taste was much diminished. At three months the wine was bright, and had been racked three times. At six months it was bright and tasted sound, but a little flat. At fourteen months it was much improved, was well flavored, mature, and with a little bouquet. At sixteen months some of it was bottled, and the rest at twenty months. At two years both wines were clear, but not bright; they were smooth and drinkable, but without distinctive character; that bottled at sixteen months was not quite clean-tasting.

No. 1299. *Kleinberger*, from Mission San José. A sample for must analysis arrived October 6, 1890, in very bad condition—too moldy to be worth making into wine. The must showed 23.7% of solid contents by spindle.

No. 1578. *Kleinberger*, from Mission San José. Received October 16, 1891, in poor condition. The must showed 26.5% of solid contents by spindle. The fermentation lasted five days, reaching its maximum temperature of 82° on the third day.

In one month the wine was bright and showed good flavor and body. At five months it showed signs of maturing quickly, developed some bouquet, and was, in general, a good wine. It was racked four times during the first year, and at fourteen months tasted quite mature and was in first-class condition. At fifteen months it was bottled.

No. 1645. *Kleinberger*, from Paso Robles station. A sample for must analysis arrived September 16, 1892, in good condition. The must showed 21.5% of solid contents by spindle.

No. 1712. *Kleinberger*, from Mission San José. Received October 6, 1892, in poor condition; nearly all the grapes were small and abortive. The must showed 24.35% of solid contents by spindle. The fermentation lasted nine days, and the maximum temperature of 80° was reached on the fourth day.

At one month the wine was clear and fresh-tasting. It was racked twice during the first three months, at the end of which time it was bright, with good bouquet, but little flavor, full acid; generally, a light, clean-tasting wine, of fair quality. At five months it showed signs of a slight acetification, due to the smallness of the sample. It was bottled at fourteen months.

No. 1880. *Kleinberger*, from Paso Robles station. Received September 16, 1893, much bruised, but not moldy, of good size, and the bunches well filled; mature, but lacking in sweetness. The must showed 19.5% of solid contents by spindle. The fermentation lasted four days, and reached its maximum temperature of 82° on the second day.

The wine was clear in three weeks, when it was racked for the second time. At three months it was bright, with some flavor and a little bouquet, good acid, and clean taste. At seven months, one month after the third racking, it was bright, pleasant, and showed signs of a quick maturity.

No. 1981. *Kleinberger*, from Tulare station. Received October 18, 1893, in good condition. The bunches were close and of medium size; the berries of medium size, thin-skinned, juicy, ripe, and with little flavor. The must showed 24.35% of solid contents by spindle. The fermentation was cool, and lasted five days.

At one month after crushing the wine was clear, with clean taste and good acid. At three months it was bright, with some bouquet and flavor, and in general the best of the Tulare white wines of this year, but, like the rest, lacking in freshness of taste. At six months it remained an agreeable wine, but had acquired a slight odor of acetic acid, on account of being in so small a keg.

No. 1990. *Kleinberger*, from Mission San José. Received October 19, 1893, in good condition. Bunches of medium size and close; berries of medium size, soft, thin-skinned, very juicy, mature. The must showed 23.5% of solid contents by spindle. The fermentation lasted five days, attaining its maximum temperature of 81° on the third day.

The wine was clear at one month, and was racked twice during the first three months, at the end of which time it was bright, clean-tasting, with little character, but fresh and with pleasing acid. After the third racking, at six months, it showed little change, but had a faintly bitter after-taste.

No. 2100. *Kleinberger*, from J. T. Doyle, Cupertino. A sample for must analysis was received November 6, 1893, in good condition. The bunches were of medium size, compact, with a good many abortive berries; berries small to over-medium, thin-skinned, very juicy, sweet, mature. The must showed 25.9% of solid contents by spindle.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF WHITE RHENISH TYPE.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at 6 to 8 Months	Body
	Johannisberg Riesling.								
487	Cupertino	1886	20.40	18.48	.65	.27	9.73	.60	1.80
742	Cupertino. (Long-pruned)	1887	21.24	20.24	.43	.40	11.00	.54	2.30
741	Cupertino. (Short-pruned)	1887	23.49	--------	.50	.36	--------	------	------
874	Cupertino	1888	22.05	23.13	.35	.31	11.18	.47	2.10
875	Cupertino	1888	22.40	22.67	.41	.29			
1139	Cupertino	1889	23.60	23.62	.60	.36	11.91	.52	1.57
1264	Cupertino	1890	22.15	--------	.66	.26	12.18	.42	2.40
2033	Cupertino	1893	25.70	--------	.65	------	--------	------	------
862	Mission San José	1888	23.96	23.61	.46	.33	--------	------	------
1068	Mission San José	1889	21.95	21.38	.43	.31	10.58	.55	2.07
1777	Mission San José	1892	22.60	--------	.62	------	--------	------	------
1994	Mission San José	1893	22.20	--------	.60	------	--------	------	------
1490	Paso Robles	1891	24.55	--------	.36	------	--------	------	------
632	St. Helena	1886	--------	--------	------	------	11.73	.56	2.10
652	Napa	1886	--------	--------	------	------	11.91	.61	1.30
538	Patchen	1886	19.30	18.29	.36	.26	8.85	.55	1.80
663	Oakville	1886	--------	--------	------	------	12.50	.38	2.60
	Average, Cupertino	------	**22.64**	**21.63**	**.54**	**.32**	**11.20**	**.49**	**2.03**
	Average, Mission San Jose	------	**22.68**	**22.49**	**.42**	**.32**	**10.58**	**.55**	**2.07**
	Red Traminer.								
1075	Cupertino	1889	26.40	26.31	.41	.41	13.91	.50	2.65
2099	Cupertino	1893	28.30	--------	.31	------	--------	------	------
1211	Fresno	1890	25.90	25.76	.52	.39	--------	------	------
1304	Mission San José	1890	25.10	--------	.38	.39	12.82	.42	2.15
2017	Mission San José	1893	25.65	24.53	.38	.26	13.73	.38	3.10
1542	Paso Robles	1891	23.70	--------	.36	------	--------	------	------
1810	Amador station	1893	23.50	--------	.50	------	--------	------	------
	Average, Cupertino	------	**27.35**	**26.31**	**.36**	**.41**	**13.91**	**.50**	**2.65**
	Average, Mission San Jose	------	**25.38**	**24.55**	**.38**	**.33**	**13.28**	**.40**	**2.67**
	Ruländer.								
1217	Fresno	1890	25.20	24.64	.41	.31	--------	------	------
1274	Cupertino	1890	23.36	--------	.55	.29	12.64	.36	2.28
2098	Cupertino	1893	31.10	--------	.48	------	--------	------	------
1315	Mission San José	1890	26.50	--------	.45	.24	15.00	.36	2.44
2018	Mission San José	1893	28.60	28.02	.50	.20	--------	------	------
2231	Mission San José	1894	25.35	--------	.55	------	--------	------	------
1802	Amador station	1893	25.00	--------	.56	------	--------	------	------
2281	Amador station	1894	24.35	--------	.50	------	--------	------	------
	Average, Cupertino	------	**27.23**	--------	**.52**	**.29**	**12.64**	**.36**	**2.28**
	Average, Mission San Jose	------	--------	**28.02**	**.50**	**.22**	**15.00**	**.36**	**2.44**
	Average, Amador station	------	**24.68**	--------	**.53**	------	--------	------	------
	Franken Riesling.								
94	St. Helena	1883	20.16	20.24	.52	.42	11.22	.38	1.57
342	Mission San José	1885	21.47	--------	.56	.39	10.58	.60	3.82
474	Mission San José	1886	19.70	--------	.59	.33	--------	------	-----
885	Mission San José	1888	22.15	21.96	.30	.35	9.54	.60	1.80
365	Patchen	1885	21.16	--------	.45	.32	11.27	.35	1.80
491	Cupertino	1886	18.60	18.58	.51	.27	8.85	.56	1.80
699	Cupertino. (Long-pruned)	1887	23.83	24.01	.45	.40	12.73	.60	2.30

SUMMARY OF ANALYSES OF MUSTS AND WINES OF WHITE RHENISH TYPE—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at 6 to 8 Months	Body
713	Cupertino. (Short-pruned)	1887	26.06	26.12	.40	.46	------	------	------
897	Cupertino. (Long-pruned)	1888	24.36	25.19	.32	.37	12.54	.55	2.00
898	Cupertino. (Short-pruned)	1888	23.56	23.81	.31	.38			
1129	Cupertino	1889	25.10	24.97	.48	.31	12.73	.33	2.05
1273	Cupertino	1890	21.92	------	.50	.24	11.09	.33	1.80
2035	Cupertino	1893	25.45	------	.46	------	------	------	------
929	Santa Cruz	1888	20.29	20.24	1.08	.25	10.25	.68	2.70
1494	Paso Robles	1891	20.40	------	.48	------	------	------	------
1642	Paso Robles	1892	23.70	------	.48	------	------	------	------
1734	Paso Robles	1892	25.90	------	.32	------	------	------	------
1883	Paso Robles	1893	21.50	20.24	.55	.32	8.85	.50	1.80
1501	Asti, Sonoma County	1891	24.40	23.90	.50	.40	12.36	.38	2.05
1805	Amador station	1893	21.70	------	.64	------	------	------	------
2284	Amador station	1894	26.30	------	.51	------	------	------	------
	Average, Cupertino	------	------	**23.78**	**.43**	**.33**	**11.59**	**.47**	**1.99**
	Average, Mission San Jose	------	------	**21.96**	**.48**	**.36**	**10.06**	**.60**	**2.61**
	Average, Paso Robles	------	**22.87**	**20.40**	**.46**	**.32**	**8.85**	**.50**	**1.80**
	Average, Amador station	------	**24.00**	------	**.58**	------	------	------	------
	Orleans.								
2031	Cupertino	1893	26.50	------	.54	------	------	------	------
2141	Amador station	1894	26.50	------	.47	------	------	------	------
2311	Tulare	1894	24.90	------	.24	------	------	------	------
	Kleinberger.								
488	Cupertino	1886	17.60	17.22	.49	.25	8.46	.47	1.80
715	Cupertino. (Long-pruned)	1887	23.40	23.61	.42	.42	12.09	.39	2.60
764	Cupertino. (Short-pruned)	1887	24.70	------	.52	------	------	------	------
865	Cupertino. (Short-pruned)	1888	22.69	23.13	.46	.36	10.83	.46	2.60
866	Cupertino. (Long-pruned)	1888	21.35	21.14	.44	.36	10.42	.52	2.05
1106	Cupertino	1889	23.90	24.12	.45	.36	12.36	.53	2.50
1282	Cupertino	1890	20.60	------	.50	.31	11.00	.40	2.32
2100	Cupertino	1893	25.90	------	.53	------	------	------	------
1088	Mission San José	1889	23.70	24.12	.55	.38	12.00	.53	2.85
1299	Mission San José	1890	23.70	------	.60	------	------	------	------
1578	Mission San José	1891	26.50	24.96	.50	.36	12.82	.49	2.55
1712	Mission San José	1892	24.35	24.20	.63	.33	10.83	.79	2.85
1990	Mission San José	1893	23.50	22.67	.63	------	11.27	.62	2.20
2242	Mission San José	1894	23.90	------	.45	------	------	------	------
1222	Fresno	1890	23.05	23.13	.54	.33	------	------	------
1645	Paso Robles	1892	21.50	------	.69	------	------	------	------
1880	Paso Robles	1893	19.50	18.58	.59	.30	9.00	.60	2.10
1981	Tulare	1893	24.35	23.21	.50	.50	11.45	.57	3.10
2341	Tulare	1894	24.80	------	.39	------	------	------	------
2144	Amador station	1894	27.10	------	.47	------	------	------	------
	Average, Cupertino	------	**22.52**	**21.84**	**.47**	**.34**	**10.86**	**.46**	**2.31**
	Average, Mission San Jose	------	**24.27**	**23.99**	**.56**	**.36**	**11.73**	**.61**	**2.61**
	Average, Paso Robles	------	**20.50**	**18.58**	**.64**	**.30**	**9.00**	**.60**	**2.10**
	Average, Tulare	------	**24.57**	**23.21**	**.44**	**.50**	**11.45**	**.57**	**3.10**

WHITE BURGUNDY TYPE.

The fine white wines of Burgundy have a reputation which is hardly second to that of Sauterne or Rhine wines. They do not possess the marked and peculiar aroma which the latter obtain from the highly flavored Riesling and Sauterne grapes from which they are made. They are, however, wines of extreme delicacy of flavor, of great smoothness, full body, and high bouquet. The famous Montrachet takes rank with Château-Iquem and Johannisberger, while the wines of Chablis and Pouilly are of world-wide renown. The best of these wines are made from the Pinot blanc Chardonay grown at medium elevations on hillsides. The Chardonay loses its high character if grown on moist valley soils or in the warmest localities. The indications are that excellent wines of this type will be made in some of the coast counties, especially in warm, well-drained locations in late localities. The grapes ripen early and more evenly than the Semillon, but must be well cared-for to avoid sunburn and drying up. On the whole, the white Burgundy grapes have shown much more promise for California than the red; and the wines do not present the same difficulties in handling and aging.

PINOT BLANC.

Synonyms: Plant doré blanc; Auvernat blanc.

Description.—This grape is simply a white-fruited variation of the ordinary Franc Pinot, which it resembles almost exactly in all characters except the color of the grapes.

It is a true Pinot with all the characteristics of growth and habit of that group, and succeeds under the same conditions. Its product resembles that of the Chardonay, but is inferior to it in all respects. Its average crop at Cupertino has been about one and a half tons per acre. The grapes ripen earlier than those of the Chardonay, are inferior in flavor, but develop a higher sugar content; the average must composition has been: at Cupertino, 26.5% of sugar and 0.56% of acid; at Mission San José, 25.5% of sugar and 0.66% of acid. In Sonoma it attains even higher sugar content, and, like its congener, Pinot noir, fails to retain sufficient acid. The wine is not very robust, and, in general, seems to have no good qualities in which it is not surpassed by the Chardonay.

Table of Production.

PINOT BLANC.	Number of Vines	Total Weight of Grapes, in lbs.	Average per Vine, in lbs.	Date of Picking
1887—No. 777. J. T. Doyle, Cupertino	20	12	0.6	Oct. 25
1888—No. 845. J. T. Doyle, Cupertino	9	42	4.6	Sept. 13
1889—Row 46. J. T. Doyle, Cupertino	9	65	7.2	Sept. 20

ANALYSES OF MUSTS AND WINES.

PINOT BLANC.	Date of Picking	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric at 6 to 8 Months	Body
						By Weight	By Volume		
1887—No. 777. J. T. Doyle, Cupertino	Oct. 25	30.00	29.83	.50	.60	------	------	------	------
1888—No. 845. J. T. Doyle, Cupertino	Sept. 13	21.50	22.05	.45	.28	9.70	12.09	.51	2.60
1889—No. 1122. J. Gallegos, Mission San José	Sept. 30	25.90	26.12	.56	.35	*	------	------	------
1890—No. 1337. J. T. Doyle, Cupertino	Oct. 10	25.90	------	.50	------	------	------	------	------
1891—No. 1517. Mission San José	Sept. 30	25.10	25.20	.75	.35	10.81	13.27	.57	2.10
No. 1593. A. Macartney, Los Guilicos	Oct. 16	26.80	25.19	.42	.36	12.15	14.90	.35	2.20
1892—No. 1621. Tulare	Aug. 28	25.20	------	.39	------	------	------	------	------
1893—No. 1944. Tulare	Oct. 15	25.00	------	.45	------	------	------	------	------
No. 2027. J. T. Doyle, Cupertino	Oct. 29	27.65	------	.78	------	------	------	------	------
1894—No. 2327. Tulare	Oct. 15	26.00	------	.42	------	------	------	------	------

* For analysis of wine, see No. 1121, Pinot Chardonay, from J. Gallegos, Mission San José.

RECORD OF TREATMENT.

No. 777. *Pinot blanc*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 26, 1887, in fair condition. The bunches were very uneven in size, and showed much early coulure; the berries showed very uneven ripening. The must showed 30.0% of solid contents by spindle and 0.50% of acid.

No. 845. *Pinot blanc*, from J. T. Doyle, Cupertino. Received September 14, 1888, in good condition. The bunches showed much early coulure. The must showed 21.5% of solid contents by spindle and 0.45% of acid. The fermentation lasted seven days, and reached its maximum temperature of 84° on the third day.

At three weeks the wine was racked for the second time and taken to the cellar. At four months it was nearly clear, of light aroma, pleasant acid and flavor, but not quite clean-tasting. The wine was pasteurized. At seven months it was clear and sound, and was racked again. At seventeen months it was bright and showed high quality, and was mature. A month later it was bottled. A year after bottling it was bright, of full and agreeable flavor, little bouquet, and lacking in freshness. At four years it was a very smooth, full-bodied wine, but rather lacking in bouquet and freshness.

No. 1122. *Pinot blanc*, from J. Gallegos, Mission San José. Received October 1, 1889, in good condition, and mature. The bunches were small, cylindrical, and loose, on thick peduncles, the berries of medium size. The must showed 25.9% of solid contents by spindle. It was fermented with No. 1121, Pinot Chardonay, from Mission San José.

No. 1337. *Pinot blanc*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 13, 1890, in fair condition. The must showed 25.9% of solid contents by spindle.

No. 1517. *Pinot blanc*, from Mission San José. Received October 1, 1891, in good condition, and mature. The must showed 25.1% of solid contents by spindle. The fermentation lasted eleven days, and reached a maximum temperature of 77° on the fourth day.

At one month from crushing the wine was clear, but still a little sweet. At three months it had been racked twice, and was clear, fresh, and fruity, with some bouquet and flavor. At five months it was bright, with good aroma, but somewhat raw. At seven months it had been racked three times, and was in good condition, very fresh and richly flavored, but without very much bouquet. It was racked again at eleven months, and at sixteen months it was bottled.

No. 1593. *Pinot blanc*, from A. Macartney, Los Guilicos. Received October 19, 1891, in fair condition, mature, a little moldy. The fermentation was prolonged, lasting over two weeks; the maximum temperature of 80° was reached on the fifth day.

The wine remained slightly sweet for over a month, but in six weeks was clear and clean-tasting. At five months it had been racked three times, and was bright, very fruity, and of high quality. At ten months it was racked for the fourth time. At sixteen months it was in good order, full-bodied, of high flavor and marked character; its only defect was a slight bitterness. A month later it was bottled.

No. 1621. *Pinot blanc*, from Tulare station. A sample for must analysis arrived September 1, 1892, in good condition. The must showed 25.2% of solid contents by spindle.

No. 1944. *Pinot blanc*, from Tulare station. A sample for must analysis arrived October 18, 1893, in good condition. The bunches were very small, irregular, and loose; the berries small, sunburned, and tasteless. The must showed 25.0% of solid contents by spindle.

No. 2027. *Pinot blanc*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 31, 1893, in good condition. The bunches were small, short, conico-cylindrical, close; the berries small, juicy, sweet, mature. The must showed 27.65% of solid contents by spindle.

PINOT BLANC CHARDONAY.

Synonyms: Melon; Epinette.

Description.—Vine more vigorous than most of the Pinots, with slender, yellowish, short-jointed canes; leaves small to medium, yellowish green, scarcely lobed and coarsely toothed; bunches small, conico-cylindrical, and compact; berries small, spherical, and with more flavor than the true Pinot blanc.

The grapes ripen a week or two later than those of the black Pinots. It is from this grape that the famous white wines of Montrachet, Chablis, and Pouilly are made. It is sometimes confused with the true Pinot, from which, however, it differs in its period of ripening (which is nearly two weeks later), the firmer flesh, and somewhat larger size of its berries, and its more pronounced flavor. It is said in France to be a less prolific bearer than the true Pinot blanc, but in California the contrary seems to be true.

The vine is a vigorous grower, free from disease, shades its grapes well, and does well on almost any well-drained soil, even on those which are too poor for most grapes. In rich valley soils it tends to go too much to wood, and requires very long canes. It is particularly suited to the northern coast counties; in Napa it is reported as producing from three to five tons per acre, doing best on the higher lands. The average crop for three years at Cupertino was 3.4 tons per acre. The average composition of the must at Cupertino and Mission San José has been 24.0% of sugar and 0.50% of acid. In the more southerly and central stations the sugar has been higher and the acid too low.

In the rich Tulare soils the crops have been small, and the grapes flavorless and injured by the sun. The wine obtained from this grape in suitable localities is well flavored, with good bouquet and body and sufficient alcohol. The points of superiority of this grape over the true Pinot Blanc are its better bearing qualities (in California), its superior aroma, and its greater adaptability to various soils.

TABLE OF PRODUCTION.

PINOT CHARDONAY.	Number of Vines......	Total Weight of Grapes, in lbs.......	Average per Vine, in lbs.	Date of Picking......
1887—No. 776 (long-pruned). J. T. Doyle, Cupertino...	20	141	7.0	Oct. 25
1888—No. 849 (long-pruned). J. T. Doyle, Cupertino...	12	127	10.5	Sept. 17
1889—No. 1110 (long-pruned). J. T. Doyle, Cupertino...	10	120	12.0	Sept. 26

Analyses of Musts and Wines.

PINOT CHARDONAY.	Date of Picking	MUST.				WINE.				
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric at Six to Eight Months	Volatile Acid	Body
						By Weight	By Volume			
1887—No. 776. J. T. Doyle, Cupertino	Oct. 23	25.65	25.19	.48	.32	9.70	12.09	.57	.05	2.60
1888—No. 849. J. T. Doyle, Cupertino	Sept. 17	21.50	22.05	.45	.28	8.34	10.42	.38	-----	2.45
No. 858. J. Gallegos, Mission San José	Sept. 24	24.24	24.54	.48	.39	9.92	12.36	.61	-----	2.80
1889—No. 1110. J. T. Doyle, Cupertino	Sept. 26	23.50	23.62	.41	.29	9.63	12.00	.53	-----	2.10
No. 1121. J. Gallegos, Mission San José	Sept. 29	25.00	24.97	.45	.42	10.16*	12.64	.45	-----	2.55
1890—No. 1375. J. T. Doyle, Cupertino	Oct. 14	21.30	-----	.70	-----	-----	-----	-----	-----	-----
No. 1357. J. Gallegos, Mission San José	Oct. 11	24.80	-----	.53	-----	-----	-----	-----	-----	-----
1891—No. 1520. J. Gallegos, Mission San José	Sept. 29	22.75	-----	.57	-----	-----	-----	-----	-----	-----
No. 1533. Paso Robles	Oct. 6	24.70	-----	.30	-----	-----	-----	-----	-----	-----
1892—No. 1622. Tulare	Aug. 29	24.35	-----	.47	-----	-----	-----	-----	-----	-----
No. 1735. Paso Robles	Oct. 10	25.90	-----	.43	-----	-----	-----	-----	-----	-----
1893—No. 1840. Amador station	Sept. 4	22.40	-----	.59	-----	-----	-----	-----	-----	-----
No. 1940. Tulare	Oct. 11	23.70	22.23	.43	.50	-----	-----	-----	-----	-----
No. 2093. Cupertino	Nov. 5	25.50	-----	.60	-----	-----	-----	-----	-----	-----
1894—No. 2161. Amador station	Sept. 19	26.10	-----	.47	-----	-----	-----	-----	-----	-----
No. 2237. Mission San José	Oct. 5	23.70	-----	.50	-----	-----	-----	-----	-----	-----
No. 2326. Tulare	Oct. 15	24.80	-----	.35	-----	-----	-----	-----	-----	-----

* Blended with No. 1122, Pinot blanc, from J. Gallegos, Mission San José.

Record of Treatment.

No. 776. *Pinot Chardonay*, from J. T. Doyle, Cupertino. Received October 25, 1887, in fair condition. The bunches were of fair size and characteristic shape, well filled, but showing some early coulure; the berries were somewhat overripe and sunburned, very sweet, but with good acid. The must showed 25.65% of solid contents by spindle and 0.48% of acid. The temperature of the grapes at crushing was 76°, and the maximum reached was 84°, on the third day. The fermentation was over on the sixth day.

On the tenth day the wine was drawn from the lees. At eight weeks it was still a little cloudy, but showed good aroma and characteristic flavor; it was full-bodied and of medium acid. Three weeks later it was racked and pasteurized for safety. At three months and a half it was clear and had developed some bouquet; it had good body and full acid. At eight months the bouquet was much improved, but the wine was not quite clean-tasting.

No. 849. *Pinot Chardonay*, from J. T. Doyle, Cupertino. Received September 18, 1888, in fair condition. Most of the bunches were very compact, triangular, double shouldered or winged; some showed a great deal of early coulure and sunburn. The overripe and crushed berries were removed before crushing. The must showed 21.5% of solid contents by spindle and 0.45% of acid. The grapes were fermented with 11½ lbs. of the pomace of No. 835, Gamai Teinturier, from Cupertino, as a red wine.

At six weeks the wine was racked and taken to the cellar. At ten weeks it was clear, but lacking in color, showed good aroma, but was not quite clean-tasting. Seven weeks later it was pasteurized for safety. At eight and a half months it was racked and put in glass. It was clear and sound. At fifteen months it had improved, and tasted mature and finished. At seventeen months it was bright and sound, with faint bouquet and agreeable flavor, having the smoothness of a white wine. At two years and five months it had improved in bouquet, flavor, and general quality, and the color had become brighter.

No. 858. *Pinot Chardonay*, from J. Gallegos, Mission San José. Received September 25, 1888. The bunches were small and compact. The must showed 24.24% of solid contents by spindle and 0.48% of acid. The fermentation was made in a hot chamber at a temperature of 93°. The wine was poor from the start, and soon became quite spoiled.

No. 1110. *Pinot Chardonay*, from J. T. Doyle, Cupertino. Received September 27, 1889, in poor condition—crushed, shriveled, and overripe. The bunches were close and small to medium in size. The must showed 23.5% of solid contents by spindle and 0.41% of acid. The fermentation was violent, reaching a maximum temperature of 81.5° on the third day, and expelling much foam from the bung-hole.

In six weeks the wine was clear, with little aroma, but otherwise of very good quality. At four months it had improved; but as the lees showed unsound germs, the wine was pasteurized. Six weeks later it was bright, of pleasing flavor and delicate bouquet. At one year it was in good condition, of good bouquet, and mature. It was racked for the fourth time, and part put in bottle. Four months later the wine in wood was bright, of fine flavor, good body and acid, and well matured. The lees showed a good deal of *S. pastorianus*. At eighteen months the wine bottled at one year was bright, clean-tasting, and sound, of higher character than that in the keg; the rest was bottled at this time. A year later the wine first bottled was as good as before, while that bottled at eighteen months had deteriorated. At three years and five months little change was to be perceived in the wines.

No. 1121. *Pinot Chardonay*, from J. Gallegos, Mission San José. Received October 1, 1889, in fair condition. The bunches were very close and some of the berries dried up. The grapes were very ripe, and the must showed 25.0% of solid contents by spindle and 0.45% of acid. The grapes were fermented with No. 1122, Pinot blanc, from Mission San José, in equal proportions. The must reached its maximum temperature on the third day, and was dry on the sixth.

On the seventh day the wine was racked off the thick lees. In six weeks it was clear, of very light color, good aroma, marked flavor, medium acid, full alcohol and body; in general, of very pleasing character. At this date it was racked and taken to the cellar. At four months it was bright and well developed, but was not quite clean-tasting. Two months later it was bright and was racked for the third time. The lees were examined and no unsound germs found. They were examined again at ten and at fifteen months, and only a few acetic germs found. At eighteen months it was bright and of good bouquet and rich flavor, but somewhat injured by too much access of air. At this date the wine was put into glass. At two years and half the wine bottled at six months had deteriorated, while that bottled at eighteen months was bright and of good quality, but not of very high bouquet. A year later the wine had much improved in bouquet.

No. 1375. *Pinot Chardonay*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 17, 1890, in fair condition; a few grapes dried, maturity complete. The must showed 21.3% of solid contents by spindle.

No. 1357. *Pinot Chardonay*, from Mission San José. A sample for must analysis arrived October 14, 1890, in good condition, and mature. The bunches were well filled and the grapes agreed well with Pulliat's description. The must showed 24.8% of solid contents by spindle.

No. 1520. *Pinot Chardonay*, from J. Gallegos, Mission San José. A sample for must analysis arrived October 1, 1890, in good condition, and mature. The must showed 22.75% of solid contents by spindle.

No. 1533. *Pinot Chardonay*, from Paso Robles station. A sample for must analysis arrived October 8, 1891, in poor condition; very small, sunburned, and not properly ripened. The must showed 24.7% of solid contents by spindle.

No. 1622. *Pinot Chardonay*, from Tulare station. A sample for must analysis arrived September 1, 1892, in good condition. The must showed 24.35% of solid contents by spindle.

No. 1735. *Pinot Chardonay*, from Paso Robles station. A sample for must analysis arrived October 13, 1892, in good condition. The must showed 25.9% of solid contents by spindle.

No. 1840. *Pinot Chardonay*, from Amador station. A sample for must analysis arrived September 8, 1893, in good condition. The bunches were small, cylindrical, and compact; the berries small, fleshy, tasteless, not quite mature. The must showed 22.4% of solid contents by spindle.

No. 1940. *Pinot Chardonay*, from Tulare station. A sample for must analysis arrived October 13, 1893, in good condition. The bunches were small, short-cylindrical, compact; the berries of medium size, slightly ovoid, flavorless, somewhat sun-dried. The must showed 23.7% of solid contents by spindle.

No. 2093. *Pinot Chardonay*, from J. T. Doyle, Cupertino. A sample for must analysis arrived November 6, 1893, in good condition. The bunches were small, compact, cylindrical, with a small wing or shoulder; the berries small, round, pulpy but soft, very sweet, but very few shriveled. The must showed 25.5% of solid contents by spindle.

SUMMARY OF ANALYSES OF MUSTS AND WINES, WHITE BURGUNDY TYPE.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric at 6 Months	Body
	Pinot blanc.								
777	Cupertino	1887	30.00	29.83	.50	.60	------	------	------
845	Cupertino	1888	21.50	22.05	.45	.28	12.09	.51	2.60
1337	Cupertino	1890	25.90	------	.50	------	------	------	------
2027	Cupertino	1893	27.65	------	.78	------	------	------	------
1122	Mission San José	1889	25.90	26.12	.56	.35	------	------	------
1517	Mission San José	1891	25.10	25.20	.75	.35	13.27	.57	2.10
1593	Los Guilicos	1891	26.80	25.19	.42	.36	14.90	.35	2.20
1621	Tulare	1892	25.20	------	.39	------	------	------	------
1944	Tulare	1893	25.00	------	.45	------	------	------	------
2327	Tulare	1894	26.00	------	.42	------	------	------	------
	Average, Cupertino	------	**26.26**	**25.94**	**.56**	**.44**	**12.09**	**.51**	**2.60**
	Average, Mission San Jose	------	**25.50**	**25.66**	**.65**	**.35**	**13.27**	**.57**	**2.10**
	Average, Tulare	------	**25.40**	------	**.42**	------	------	------	------
	Pinot blanc Chardonay.								
776	Cupertino	1887	25.65	------	.48	.32	12.09	.57	2.60
849	Cupertino	1888	21.50	------	.45	.28	------	------	------
1110	Cupertino	1889	23.50	------	.41	.29	12.00	.53	2.10
1375	Cupertino	1890	21.30	------	.70	------	------	------	------
2093	Cupertino	1893	25.50	------	.60	------	------	------	------
858	Mission San José	1888	24.24	------	.48	.39	12.36	.61	2.80
1121	Mission San José	1889	25.00	------	.45	------	------	------	------
1357	Mission San José	1890	24.80	------	.53	------	------	------	------
1520	Mission San José	1891	22.75	------	.57	------	------	------	------
2237	Mission San José	1894	23.70	------	.50	------	------	------	------
1533	Paso Robles	1891	24.70	------	.30	------	------	------	------
1735	Paso Robles	1892	25.90	------	.43	------	------	------	------
1622	Tulare	1892	24.35	------	.47	------	------	------	------
1940	Tulare	1893	23.70	------	.43	.50	------	------	------
2326	Tulare	1894	24.80	------	.35	------	------	------	------
1840	Amador station	1893	22.40	------	.59	------	------	----	------
2161	Amador station	1894	26.10	------	.47	------	------	------	------
	Average, Cupertino	------	**23.49**	------	**.53**	**.29**	**12.04**	**.55**	**2.35**
	Average, Mission San Jose	------	**24.09**	------	**.51**	**.39**	**12.36**	**.61**	**2.80**
	Average, Paso Robles	------	**25.30**	------	**.66**	------	------	------	------
	Average, Tulare	------	**24.38**	------	**.42**	**.50**	------	------	------
	Average, Amador station	------	**24.25**	------	**.53**	------	------	------	------

SAUTERNE TYPE.

The attempt to reproduce European types of wines in California has been particularly successful in the case of Sauternes, and there is little doubt that if we could afford to exercise the minute care of some of the wine-makers of the Gironde, some of our products would equal their "premiers crus." It is a well-recognized fact in the Sauternes district that the superiority of the "premiers crus" over the "deuxièmes crus" is due, in most cases, principally to the exercise of greater care and skill, and not to superiority of soil or location. Vineyards which formerly produced wines of second quality, now, by the adoption of better methods, are made to produce wines of first quality. This plainly indicates the direction in which our efforts to improve our Sauternes should tend. Though we will probably never find it profitable to gather the grapes berry by berry, as is done at Château-Iquem, we may very much improve the average quality of our grapes by intelligent pruning and cultivation of the vines. Even the selection of bunches is at present impracticable with the unpracticed pickers who must usually be employed.

One of the most important objects to be kept in view, therefore, is uniformity in the ripening of the grapes. This is almost impossible by the ordinary method of pruning the vines to a head and tying the long canes up to a stake. By this method the grapes on different parts of the vine are exposed to very different conditions of light, heat, and moisture. This is particularly the case with the Sauterne varieties, on account of their heavy foliage and their habit of producing both on the spurs and on the canes. Some method of training, therefore, should be adopted which will place every bunch as nearly as possible under the same conditions of exposure. This is probably most easily and economically obtained by the use of a single wire at about fifteen inches from the soil, to which the vines are tied. The Sauterne varieties lend themselves very readily to this method of training, and the greater regularity of bearing, as well as of ripening, amply repay the extra outlay.

The Semillon, Sauvignon blanc, and Muscadelle are the varieties from which, here as in France, the finest Sauternes are made. For good wines of the second grade a certain proportion of Sauvignon vert is without doubt an improvement on Folle blanche, which is used for this purpose in France.

SEMILLON.

(See Vit. Rept. 1883–85, p. 119; 1885–86, p. 92.)

Synonyms: Colombier; Chevrier; Goulu blanc.

Description.—Rather vigorous; canes semi-erect, vigorous, long, slightly flattened, mahogany colored, and with fairly long internodes; leaves large, thick, three or five lobed; petiolar sinus U-shaped, lower lateral sinuses deep; teeth short, unequal, generally obtuse; upper surface pale green, glabrous, wavy; lower surface slightly downy; bunch large, well filled, conico-cylindrical, winged; berries of good size, nearly round, transparent and of a fine golden color when mature, sweet, thin-skinned, and with a marked and agreeable flavor. The grapes ripen in the second epoch.

The Semillon is perhaps the most famous of the French white grapes, uniting excellence of quality with abundance of production in a more marked degree than any other variety. Mixed with the Sauvignon and the Muscadelle, it produces the highest class Sauternes. The vines have unfortunately the defect of starting too soon, and thus being exposed to injury by frost; they are also subject to rots, but resist *Peronospora* well. The soil best suited to this variety is a strong, calcareous clay on a gravelly marl subsoil.

This grape has given satisfaction in more localities in California than perhaps any other white variety that has been tried. It is especially valuable in the warmer parts of the coast valleys. It has been planted somewhat extensively in Napa, Sonoma, Santa Clara, and Alameda, proving itself a vigorous grower, shading its grapes well, a reliable bearer, though at times subject to coulure, comparatively free from disease, and easy to graft upon resistant stocks. It has produced satisfactory crops, both with long and with half-long pruning; it is especially adapted to the curved-cane system of pruning, which is practiced in the Sauterne district, where this variety originated. In France it is often pruned short, but with the wide planting usual in California it requires long or half-long canes to yield satisfactory crops. It is reported as yielding from 1½ to 2 tons per acre on light hill soils, and from 4 to 5 tons per acre on rich and valley soils. The average yield for three years at the experimental plot in Santa Clara County was 3.68 tons per acre for the long-pruned and 1.21 tons for the short-pruned vines. At the Fresno and Tulare experimental plots the yield has been very small, not exceeding 1 ton per acre. In San Diego it is reported as a shy bearer.

The must is characterized, in general, by somewhat high sugar contents and low to medium acid; the wine is therefore very apt to retain a little sugar after fermentation, making it very suitable for the production of wines similar to the Sauternes which it produces in France. Notwithstanding its failure to ferment-out quite dry, it is not a difficult wine to handle. With proper care, and without the deplorably excessive use of sulphur fumes in which some wine-makers indulge, it may be brought into perfect condition. The large quantities of sulphurous acid with which some of our otherwise good California wines are impregnated cannot be too strongly deprecated, for it is not only injurious to their quality and wholesomeness, but is also unnecessary. The proof of this is that there are some most excellent California Sauternes on the market, which are quite or very nearly free from any sulphurous taint, showing that, at most, there has been but a very limited and reasonable use of sulphur fumes in their preparation, and that it is therefore possible, by careful handling, to avoid the use of any such excess as is now shown, even by some very prominent brands.

TABLE OF PRODUCTION.

SEMILLON.	Number of Vines	Total Weight of Grapes, in lbs.	Average per Vine, in lbs.	Date of Picking
1887—No. 745 (long-pruned). J. T. Doyle, Cupertino	20	144	7.2	Oct. 16
No. 750 (long-pruned). J. T. Doyle, Cupertino	20	154	7.7	Oct. 18
No. 753 (short pruned). J. T. Doyle, Cupertino	20	47	2.3	Oct. 19
1888—No. 899 (short-pruned). J. T. Doyle, Cupertino	20	95	4.7	Oct. 8
No. 900 (long-pruned). J. T. Doyle, Cupertino	20	320	16.0	Oct. 8
1889—No. 1131 (half-long-pruned). J. T. Doyle, Cupertino	19	225	11.8	Sept. 29
Row 45 (long-pruned). J. T. Doyle, Cupertino	19	250	13.1	Oct. 2
Row 93 (half-long-pruned). J. T. Doyle, Cupertino	20	175	8.7	Oct. 1

ANALYSES OF MUSTS AND WINES.

SEMILLON.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six to Eight Months	Volatile Acid	Body	Ash
						By Weight	By Volume				
1883—No. 106.* J. H. Drummond, Glen Ellen						8.48	10.58	.38		1.52	.22
1884—No. 251. Natoma Wine Co., Natoma	Sept. 6	18.83	18.89	.54	.28						
No. 252. Natoma Wine Co., Natoma	Sept. 20	21.69	20.99	.42	.28	9.92	12.36	.45		1.93	.18
1885—No. 339. H. Keatinge, Lower Lake		22.89		.55	.32						
No. 434.* J. B. Portal, San José						10.54	13.00	.51		1.80	.17
1886—No. 502. J. T. Doyle, Cupertino		18.40	18.29	.57	.23	7.16	8.93	.69			
1887—No. 745 (long-pruned). J. T. Doyle, Cupertino	Oct. 16	24.89	24.12	.50	.40	10.07	12.54	.52	.14	2.80	
No. 750 (long-pruned). J. T. Doyle, Cupertino	Oct. 18	24.04	22.23	.54	.43	9.12	11.36	.47	.05	2.60	
No. 753 (short-pruned). J. T. Doyle, Cupertino	Oct. 19	25.26	25.53	.44	.45	10.35	12.82	.66	.06	2.10	
1888—No. 899 (short-pruned). J. T. Doyle, Cupertino	Oct. 8	23.54	24.34	.34	.41	9.20	11.45	.54		2.60	
No. 900 (long-pruned). J. T. Doyle, Cupertino	Oct. 8	22.81	22.85	.34	.42	9.05	11.27	.44		2.35	
1889—No. 1015. Margherita Vineyard, Fresno	Aug. 17	26.90	26.99	.31	.60						
No. 1131. J. T. Doyle, Cupertino	Sept. 29	24.10	24.64	.41	.27	10.44	12.91	.44		2.30	
1890—No. 1216. Margherita Vineyard, Fresno	Aug. 23	25.90	24.10	.32	.35						
No. 1329. J. T. Doyle, Cupertino	Oct. 10	23.70		.57							
1891—No. 1556. Paso Robles	Oct. 6	26.90		.38							
1892—No. 1648. Paso Robles	Sept. 13	22.15		.51							
No. 1668. Tulare	Sept. 16	24.00	24.64	.36	.45	10.07	12.54	.59		3.30	
No. 1739. Paso Robles	Oct. 10	25.50		.39							
No. 1657. Amador station	Sept. 16	23.65		.48							
1893—No. 1798. Tulare	Aug. 30	21.50	20.24	.50	.28	7.64	9.50	.50			
No. 1818. Amador station	Sept. 7	20.90	19.89	.63	.28						
No. 2030. J. T. Doyle, Cupertino	Oct. 30	24.55		.60							
1894—No. 2155. Tulare	Sept. 17	25.20		.35							
No. 2158. Amador station	Sept. 19	26.90		.38							

* Wines sent for examination.

Record of Treatment.

No. 745. *Semillon*, from J. T. Doyle, Cupertino. Received October 18, 1887, in fair condition. The grapes were from long-pruned vines. Many of the berries were dry or half-dried and some crushed, but none moldy. The bunches were of good size, well shouldered, and with little or no coulure. The must showed 24.89% of solid contents by spindle and 0.50% of acid. The temperature of the grapes at crushing was 75°, and the maximum reached was 89°, on the second day. The fermentation was over on the twelfth day, and the wine was drawn off on the fourteenth.

At two months the wine showed a very pronounced aroma, but less marked than that of No. 750; the acid was very agreeable. A month later it was racked for the second time. At eight months it was pleasant and vinous, had developed some bouquet, was heavy-bodied, and with pleasing but rather low acid. The flavor was exceedingly agreeable, but not so marked as that of No. 750. Two weeks later the lees showed some unsound germs, so the wine was drawn off and pasteurized. At ten months the wine was in good condition, with characteristic and fairly developed bouquet, of medium acid and alcohol; on the whole, very pleasing.

No. 750. *Semillon*, from J. T. Doyle, Cupertino. Received October 19, 1887, in good condition. The grapes were from long-pruned vines of another row than No. 745. The grapes were in good condition, and more highly flavored than those of No. 745. The must showed 24.04% of solid contents by spindle and 0.54% of acid. The temperature of the grapes at crushing was 73°, and the maximum reached was 83°, on the second day. The must was aërated twice on the second and third days, and once on the third and fourth. In six days the wine was nearly dry and clear.

In ten days the wine was drawn off the lees. At two months it was slightly cloudy, with good aroma and medium acid. At three months it was racked for the second time, and at four months racked and pasteurized. At eight months it was bright, with pronounced and characteristic aroma, heavy body, and pleasant acid; wine soft and pleasing, but almost too highly flavored.

No. 753. *Semillon*, from J. T. Doyle, Cupertino. Received October 20, 1887, in good condition. The grapes were from short-pruned vines, and were somewhat larger and less dried-up than the grapes from long-pruned vines; they also showed less coulure and more delicate flavor. The must showed 25.26% of solid contents by spindle and 0.44% of acid. The temperature of the grapes at crushing was 78°, and the maximum reached was 81.5°, on the third day. The fermentation was over on the tenth day.

At two weeks the wine was drawn off the thick lees and taken to the cellar. At two months it was still cloudy, but soft, clean-tasting, and sound; its aroma and flavor were well marked, but more delicate than those of the wines from long-pruned vines. At three months the wine was racked for the second time, and at six months, as the lees showed some unsound ferments, it was racked again and pasteurized. On account of the smallness of the quantity, it was put in glass. At eight months it was bright, with well-developed and characteristic bouquet, somewhat high and sharp acid for Semillon, heavy-bodied, and not quite clean-tasting.

No. 899. *Semillon*, from J. T. Doyle. Cupertino. Received October 10, 1888, in fair condition. The grapes were from short-pruned vines, and showed a great deal of early coulure; some bunches had dried and half-dried berries. The must showed 23.54% of solid contents by spindle and 0.34% of acid. The temperature of the grapes at crushing was 76°, and the maximum reached was 83°, on the third day. Fermentation was over on the twelfth day, when it was drawn off.

At one month the wine was racked off and taken to the cellar. At three months it was clear, of good aroma, medium body; in general, pleasing and sound. Two months later the lees showed some unsound germs, so the wine was drawn off and pasteurized. At eight months it was racked again; it showed more flavor and aroma than No. 900, and had developed well since the last tasting. At sixteen months an examination of the lees showed no unsound germs; the wine was bright and tasted mature, but had developed very little bouquet. A month later it was put into glass. At two years and four months it was bright, clean-tasting, smooth, and agreeable, but without very marked flavor or bouquet. At three years the wine had made some deposit in the bottles, so it was rebottled. Six months later the wine was bright, had made little deposit, showed good bouquet, flavor, body, and alcohol. At four years it was a well-developed, rich wine, of fine character.

No. 900. *Semillon*, from J. T. Doyle, Cupertino. Received October 10, 1888, in good condition. The grapes were from long-pruned vines, and showed less coulure than No. 899, and fewer dried berries. The must showed 22.81% of solid contents by spindle and 0.34% of acid. The temperature of the grapes at crushing was 77°, and the maximum reached was 85°, on the third day. Fermentation was over on the twelfth day, when the wine was drawn off.

At one month the wine was racked and taken to the cellar. At three months it was almost clear, of medium acid, full alcohol, and fair aroma. Two months later a microscopical examination of the lees showed no unsound germs, and the wine was racked for the third time. At ten months it was not quite bright, but showed some bouquet, and agreeable flavor; general quality, smooth and good. At thirteen months the wine was nearly bright; some wine in bottle was clear and sound, but undeveloped. At sixteen months the microscope showed the lees to be sound; the wine was bright, improved in bouquet and flavor, and nearly mature. It was at this time superior to No. 899, which was in a smaller keg. Two weeks later it was racked again. At twenty-one months the lees showed a few bitter germs, but the wine was bright, of fine amber color, rich bouquet and flavor, clean-tasting, and mature. After this, as the wine was not bottled, it deteriorated.

No. 1015. *Semillon*, from Fresno. A sample for must analysis was received August 20, 1889, perfectly ripe, but in bad condition. The grapes were typical in appearance, but had little of the characteristic flavor of the variety. The must showed 26.9% of solid contents by spindle and 0.31% of acid.

No. 1131. *Semillon*, from J. T. Doyle, Cupertino. Received October 1, 1889, in fair condition. The grapes were typical in appearance and fully ripe, some of the berries being dried. The must showed 24.1% of solid contents by spindle and 0.41% of acid. The grapes were fermented with No. 1134, Sauvignon blanc, from Cupertino. The temperature of the grapes at crushing was 70°, and the maximum reached was 81.5°, on the third day. The wine was dry on the fourth day, and was drawn off. The proportion in which the grapes were mixed was Semillon six sevenths and Sauvignon one seventh.

In two months the wine was clear, of very light color, full and agreeable flavor, but not very marked aroma, clean taste, medium acid, and good body. At this time the wine was racked for the second time and taken to the cellar. Six weeks later the wine was in good condition, of very pleasing flavor, and generally improved and promising. The lees were examined under the microscope, and found to be sound. The lees were examined again at nine and at fifteen months, and no unsound germs found. At eight months the wine was bright, clean-tasting and good, but not very well developed. At fifteen months it had developed some bouquet, and was a wine of high quality. At seventeen months some wine which had been put in glass at seven months was tasted; it was bright and had made no deposit, but it was not as well developed as the wine in wood. At this date the wine was racked again, and some put in bottles. The rest was bottled at twenty months. At two years and five months the wine bottled at seven months showed very full and characteristic flavor and aroma, but was not quite clean-tasting. That bottled at seventeen months was less marked in character, but very smooth and pleasing; the wine bottled later was not quite equal to the latter. A year later the wine bottled at seventeen months retained its high quality, and had changed little.

No. 1216. *Semillon*, from Margherita Vineyard, Fresno. A sample for must analysis arrived August 25, 1890, in somewhat damaged condition, and overripe. The juice showed 25.9% of solid contents by spindle.

No. 1329. *Semillon*, from Cupertino. Arrived October 13, 1890, in fair condition; some dried berries. The sample was for must analysis only; solid contents by spindle, 23.7%.

No. 1556. *Semillon*, from Paso Robles station. Arrived October 8, 1891, in fair condition. The sample was for must analysis only; small bunches of fair-sized berries, a little sunburnt, mature. Solid contents by spindle, 26.9%.

No. 1648. *Semillon*, from Paso Robles station. A sample for must analysis only, arrived September 16, 1892, in good condition. Solid contents by spindle, 22.15%.

No. 1668. *Semillon*, from Tulare station. Arrived September 19, 1892, in good condition. The grapes were crushed the same day, and fermented with No. 1669, Sauvignon Vert, from the same locality. The must showed 24.0% of solid contents by spindle. Fermentation was somewhat slow, but thorough; attained its maximum of 82° on September 23d, and was through September 28th, when the wine was drawn off.

The wine was racked three times during the first year. At three months it was perfectly dry and bright, became slightly cloudy during the spring months, but cleared again and remained sound to the end. The wine was at first smooth and agreeable, of low acid, with some bouquet and flavor; at one year it was not so good, lacking somewhat in freshness and cleanness of after-taste.

No. 1739. *Semillon*, from Paso Robles station. A sample for must analysis arrived October 13, 1892, in good condition. Solid contents by spindle, 25.5%.

No. 1657. *Semillon*, from Amador station. A sample for must analysis arrived on September 19, 1892, in poor condition. Solid centents by spindle, 23.65%.

No. 1798. *Semillon*, from Tulare station. Received August 31, 1893, in good condition. Bunches of good size and fairly well filled; grapes rather soft and juicy, with little flavor. Must showed 21.5% of solid contents by spindle. Fermentation was quick, but cool, lasting five days and attaining a maximum temperature of 82°. On the sixth day from crushing the wine was drawn off.

The wine was clear, and was racked four weeks after crushing. At four months the wine was bright, with a little bouquet and flavor, fuller acid and fresher taste than most of the Tulare wines. After this it deteriorated, becoming *eventé*, on account of the small size of the keg.

No. 1818. *Semillon*, from Amador station. Received September 8, 1893, in good condition. Berries in small bunches, small, well colored, and of good but not pronounced flavor. Must showed 20.9% of solid contents by spindle.

No. 2030. *Semillon*, from J. T. Doyle, Cupertino. Arrived October 31, 1893, in good condition. Bunches and berries were of medium size; grapes juicy, thin-skinned, highly flavored, and mature. The sample was for must analysis only; solid contents by spindle, 24.55%.

SAUVIGNON BLANC.

(See Vit. Rept. 1883-85, p. 120.)

Synonyms: Sauvignon jaune; Blanc Fumé.

The Sauvignon is more widely distributed than the Semillon, as it forms not only an important ingredient of the wines of the Sauterne type in the Gironde, but is also well known southward to the Pyrenees, northward to the Loire, and eastward to the Rhone. Being only of fair vigor and rather a shy bearer, but of high quality, it is chiefly used in blending with both red and white wines of other varieties, to which it imparts its fine and delicate flavor, while at the same time losing the slight harshness that characterizes its wines during the first years. The Sauvignon is pruned short in the Sauterne district, and this should be done wherever the soil is not rich, as otherwise the vine will be too soon exhausted. It ripens somewhat after the middle of the season. At Natoma the grapes were gathered fairly ripe on September 6th, fully ripe on September 17th, with the Semillon, and overripe on September 30th.

Description.—Vine less vigorous than the Semillon, and with smaller canes; leaves medium to small, round, generally three-lobed, with closed sinuses, glabrous and dark green above and with a flocculent down below; bunches small, conico-cylindrical, close; berries of medium size, slightly oval, on slender pedicels, juicy, with thick but tender skin, and very aromatic flavor.

The Sauvignon has shown that it retains its distinctive and high quality at least in the coast counties of California, but its bearing has been deficient. It has not shown itself to be as well adapted to our conditions as the Semillon, and should only be planted in small quantity to give character to more neutral grapes. In the rich soils of the interior valleys it loses a great part of its character. It is pruned short in the Sauterne district, but seems to need long canes in California. The grapes ripen later than those of the Riesling and earlier than those of the Sauvignon vert; they easily and constantly attain a full percentage of sugar, and maintain their acid well, even in the San Joaquin Valley.

ANALYSES OF MUSTS AND WINES.

SAUVIGNON BLANC.	Date of Picking	MUST.				WINE.				
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Volatile Acid	Body
1884—No. 253. Natoma Wine Company, Natoma	------	21.66	21.22	.62	.31	10.26	12.75	.55	.19	2.18
No. 254. Natoma Wine Company, Natoma	------	22.20	20.99	.53	.29	9.92	12.36	.45	.16	2.10
1885—No. 335. H. Keatinge, Lower Lake	------	24.20	------	.59	------	------	------	------	------	------
1889—No. 1032. Margherita Vineyard, Fresno	Aug. 30	23.76	23.61	.79	.60	------	------	------	------	------
No. 1134.* J. T. Doyle, Cupertino	Oct. 2	26.10	26.12	.58	.37	------	------	------	------	------
1890—No. 1317. J. T. Doyle, Cupertino	Oct. 10	25.00	------	.58	.20	12.39	15.20	.48	------	2.12
1891—No. 1464. Fresno	Aug. 28	23.50	------	.76	.46	8.84	11.00	.53	------	2.74
1894—No. 2325. Tulare	Oct. 15	24.50	------	.35	------	------	------	------	------	------

* Fermented with No. 1131, Semillon.

RECORD OF TREATMENT.

No. 1032. *Sauvignon blanc*, from Margherita Vineyard, Fresno. A sample for must analysis was received September 2, 1889, in fair condition. The grapes, which were very ripe, were of typical appearance, but lacked the characteristic flavor of the variety. The must showed 23.76% of solid contents by spindle and 0.79% of acid.

No. 1134. *Sauvignon blanc*, from J. T. Doyle, Cupertino. Received October 3, 1889, in good condition, and mature. The bunches were small, cylindrical, and rather compact; the berries from small to average, slightly oval, with rather thick but tender skin, green, and covered with brownish spots; flesh tender and juicy, and with very marked flavor. The must showed 26.1% of solid contents by spindle and 0.58% of acid. The grapes were fermented with No. 1131, Semillon.

No. 1317. *Sauvignon blanc*, from J. T. Doyle, Cupertino. Received October 13, 1890, in rather poor condition. The must showed 25.0% of solid contents by spindle and 0.58% of acid. The temperature of the grapes at crushing was 65°, and the maximum reached was 80°, on the fourth day. The wine was drawn off the thick lees on the seventh day.

At three weeks the wine was still cloudy. At six weeks it was quite clear, had good aroma, full and pleasing flavor, medium acid, good body, and was generally of good quality. At four months the wine was racked for the second time. Examinations of the lees at six weeks and at three months showed no bad germs. At five months a few acetic germs were seen, but two months later the lees were quite sound. At six months the wine was bright, sound, and maturing well. At fifteen months it was in good order, showed full, rich bouquet and flavor, and was very characteristic, well matured, and of high quality. At seventeen months it was racked and part put in bottle; at twenty-two months the rest was bottled. At three years both bottlings were bright and had thrown no deposit. They both showed good bouquet and full, rich flavor; that bottled later was smoother and cleaner-tasting than the other, but deeper in color.

No. 1464. *Sauvignon blanc*, from Fresno. Received August 31, 1891, in fair condition. The must showed 23.5% of solid contents by spindle and 0.76% of acid. The temperature of the grapes at crushing was 70°, and the maximum reached was 82°, on the third day. On the fifth day the wine was dry, and was drawn off the thick lees.

In two weeks the wine was nearly clear. At six weeks it was bright, showed some aroma, good flavor, clean taste, and good acid. At two months it was racked and taken to the cellar. At four months it was in good order, and showed good bouquet and flavor. The lees were examined microscopically at four and at seven months, and found to be sound. At seven months the wine was bright, sound, and pleasing; it was nearly mature, and at nine months it was bottled. The wine remained clear in the bottle, but became flat, owing partly to the smallness of the quantity made.

SAUVIGNON VERT.

(See Vit. Rept. 1885–86, p. 92.)

Synonyms: Green Riesling (Napa); Colombar (in California); Colombaud (?).

There is some doubt about the identity of the Sauvignon vert. In this State it is commonly called the Colombar, which is a mere corruption of Colombaud, a well-known French variety. The following description of the Colombaud is taken from Foëx: "Vine very vigorous; canes erect, thick, with medium internodes; leaves of average size, the petiolar sinus deep and almost closed, lateral sinus shallow, teeth sharp and in two series, the upper surface glabrous and almost shining, the lower surface slightly downy; bunch of average size, somewhat irregular, winged, and close; berries large, spherical, transparent, of a greenish-white, becoming yellow and a little rusty on the side exposed to the sun, thin-skinned, and agreeable to eat; they ripen somewhat late."

This description serves very well in most essentials for the Sauvignon vert as grown in California, though the form of the leaf is not quite as described. The Colombaud is, like most of the white vines of Provence, very hardy; it grows well, even in soils the least favorable to the vine. On account of its thin skin it rots easily in damp places, and it is subject to coulure in poor soils. It is best suited to rich, warm, well-drained soils. On account of its vigor, it resisted the phylloxera longer than almost any other variety in the south of France.

In California the Sauvignon vert has shown itself a very good bearer almost everywhere, except on heavy clay soils, where it is apt (especially if pruned short) to develop too much foliage and to be injured by *oidium*. Like the Semillon, it is at home in the hill soils of the coast valleys, where it gives large crops, which ripen well and develop high sugar with comparatively low acid. It gives a wine of high flavor and aroma, but not particularly robust, and which, unless blended, is difficult to keep. In Tulare and Fresno, on the contrary, it retains for the locality a relatively good amount of acid at maturity, and produces a wine of considerable merit with regard to quality, but as usual difficult to keep when pure.

Its bearing at Tulare has not been very satisfactory, being below two tons per acre. It might be used in that locality as a blend with neutral wines, on account of its marked flavor, but there are others more satisfactory for that purpose. When grown on well-drained, light soils, it produces an excellent wine of the Sauterne type, but when grown on richer soils the wine produced is lacking in keeping qualities. When grown under the conditions where it gives the best results, it produces an average of from three to five tons per acre. It has been noted by Mr. F. Swett, of Martinez, Contra Costa County, that this variety has the valuable quality of bearing grapes on canes from adventitious buds, thus insuring a crop even after the first growth of canes has been destroyed by frost. At the Paso Robles experiment station this variety has uniformly produced grapes with a particularly low percentage of acid, and is, therefore, not to be recommended for that locality as a grape for dry wines.

ANALYSES OF MUSTS AND WINES.

SAUVIGNON VERT.	Date of Picking	MUST.				WINE.				
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Volatile Acid	Body
1886—No. 490. J. T. Doyle, Cupertino	------	18.70	18.71	.42	.26	7.09	8.85	.53	------	1.75
1887—No. 697 (long-pruned). J. T. Doyle, Cupertino	Oct. 5	23.01	23.23	.39	.34	9.63	12.00	.75	.12	2 20
No. 708 (short-pruned). J. T. Doyle, Cupertino	Oct. 10	25.67	26.00	.47	.54	11.00	13.45	.44	------	2.60
No. 724. J. P. Smith, Livermore	Oct. 12	22.67	22.67	.30	.42	9.49	11.82	.47	.09	2.60
1888—No. 880 (short-pruned). J. T. Doyle, Cupertino	Oct. 3	21.39	21.38	.28	.40	7.92	9.90	.45	------	2 33
No. 881 (long-pruned). J. T. Doyle, Cupertino	Oct. 3	21.55	22.23	.27	.24					
1889—No. 1018. Margherita Vineyard, Fresno	Sept. 1	24.50	25.19	.46	.66	------	------	------	------	------
No. 1095. Margherita Vineyard, Fresno	Sept. 18	21.50	21.38	.58	.48	8.84	11.00	.47	------	2.70
No. 1130. J. T. Doyle, Cupertino	Oct. 1	23.30	22.95	.38	.39	9.56	11.91	.40	------	2.40
1890—No. 1220. Margherita Vineyard, Fresno	Aug. 23	23.70	23.61	.47	.45	------	------	------	------	------
No. 1275. J. T. Doyle, Cupertino	Sept. 30	19.30	------	.51	.24	8.20	10.25	.42	------	2.20
1891—No. 1433. Tulare	Aug. 25	20.85	------	.30	.61	------	------	------	------	------
No. 1455. Fresno	Aug. 27	21.50	------	.68	------	8.91	11.09	.49	------	2.60
No. 1513. Calistoga	Sept. 27	24.25	21.38	.53	.35	10.54	13.09	.53	------	2.20
No. 1514. Asti, Sonoma County	Sept. 28	22.70	21.38	.44	.30	9.20	11.45	.53	------	2.55
No. 1540. Paso Robles	Oct. 6	25.55	------	.22	------	------	------	------	------	------
1892—No. 1669. Tulare	Sept. 16	25.45	25.53	.37	.49	------	------	------	------	------
No. 1733. Paso Robles	Oct. 10	23.70	------	.35	------	------	------	------	------	------
1893—No. 1821. Amador station	Sept. 6	22.60	21.38	.59	.21	------	------	------	------	------
No. 1847. Tulare	Sept. 13	23.70	21.80	.54	.51	9.20	11.45	.44	------	2.60
No. 1961. Paso Robles	Oct. 12	29.30	------	.32	------	------	------	------	------	------
No. 2091. Cupertino	Nov. 5	24.10	------	.61	------	------	------	------	------	------
1894—No. 2157. Amador station	Sept. 19	26.90	------	.38	------	------	------	------	------	------
No. 2218. Paso Robles	Sept. 28	25.65	------	.30	------	------	------	------	------	------
No. 2287. Tulare	Oct. 6	26.90	25.19	.38	------	10.35	12.82	.41	------	2.30

RECORD OF TREATMENT.

No. 697. *Sauvignon vert*, from J. T. Doyle, Cupertino. Received October 6, 1887, in good condition. The grapes were from long-pruned vines, and showed some coulure. Both bunches and berries were large, the latter very sweet and thin-skinned. The must showed 23.01% of solid contents by spindle and 0.39% of acid. The temperature of the grapes at crushing was 65°, and the maximum reached was 89°, on the fourth day. The fermentation was over on the tenth day. At twelve days the wine was drawn off the thick lees.

At two months the wine was bright, with little aroma, medium acid, pleasant, smooth, and full-bodied. Five months later the lees showed some unsound germs, so the wine was drawn off and pasteurized. Six weeks after pasteurizing it was a bright, fine-flavored, and good wine, with pronounced bouquet, but rather sharp acid.

No. 708. *Sauvignon vert*, from J. T. Doyle, Cupertino. Received October 11, 1887, in good condition. The grapes were from short-pruned vines, and showed very little coulure. The bunches were large and full, contrasting favorably with those from the long-pruned vines; the berries were smaller, on the average, in the latter lot. The must showed 25.67% of solid contents by spindle and 0.47% of acid. The temperature of the grapes at crushing was 70°, and the maximum reached was 81°, on the third day. In six days the fermentation was over.

At three weeks the wine was drawn off the lees. At two months it was still cloudy, but tasted sound; had light, pleasant acid and fair aroma. A microscopic examination of the lees showed no unsound germs. At three months the wine was racked again, and at eight months it was almost bright; it had developed some bouquet, and would have been a good wine but that it was not quite clean-tasting.

No. 724. *Sauvignon vert*, from J. P. Smith, Livermore. Received October 13, 1887, in good condition, although somewhat crushed in transit. The bunches were large and heavily shouldered, but showed some coulure. The berries were somewhat smaller than those of the same variety from Cupertino; they were very juicy, thin-skinned, and sweet. The must showed 22.67% of solid contents by spindle and 0.30% of acid. The temperature of the grapes at crushing was 69.5°, and the maximum reached was 85°, on the third day. In two weeks the fermentation was over. At eighteen days the wine was drawn off the lees.

At two months it was still cloudy, but sound and agreeable. At three months it was racked again. At five months it was racked for the third time and pasteurized. At eight months it was bright and sound; it showed moderate acid, heavy body, and some bouquet—altogether, a wine of very good quality.

Nos. 880 and 881. *Sauvignon vert*, from J. T. Doyle, Cupertino. Received October 5, 1888, in good condition. No. 880 was from short-pruned and No. 881 from long-pruned vines. The grapes from the long-pruned vines showed the most coulure. The must showed 21.39% of solid contents by spindle and 0.28% of acid for the short-pruned; and 21.55% of solid contents by spindle and 0.27% of acid for the long-pruned. The grapes were crushed and fermented together. The maximum temperature, reached the third day, was 86.5°, and the time of fermentation eleven days.

At one month the wine was racked and taken to the cellar. At three months it was clear and of good flavor and aroma; but as the lees were not quite right, the wine was pasteurized. Three months after pasteurizing it was racked and part put in bottle. At ten months it was bright, of light golden color, marked and agreeable flavor, medium acid, good body; rather astringent for a white wine, general quality good. At fourteen months the wine put in bottle at six months was perfectly sound, of agreeable character, and well developed. At sixteen months the lees were sound and the wine was in good order, of good bouquet and advanced development. A month later it was racked again, and a part bottled. At twenty-two months the rest of the wine was bottled; it was bright, smooth, and agreeable, with low acid; the lees were sound. At twenty-eight months the wine bottled at six months was clear, clean-tasting, and of good quality, except for the odor, which was not pleasing; that bottled at seventeen months had less flavor than the above; that bottled at twenty-two months was the only one that had made no deposit in the bottle, but it had less character than the others. At three years and ten months the wine bottled at seventeen months was much the best of the three; it was a wine of high quality, full flavor, and rich bouquet; it had deposited a slight but well-settled deposit.

No. 1018. *Sauvignon vert*, from Fresno. A sample for must analysis was received September 2, 1889, in fair condition. The grapes were overripe, and showed little of the characteristic flavor of the variety. The must showed 24.5% of solid contents by spindle and 0.46% of acid.

No. 1095. *Sauvignon vert*, from Fresno. Received September 20, 1889, in good condition. The grapes came from the Margherita Vineyard, and were less ripe than those from the experimental plot. The bunches were of medium size, cylindrical, and winged; the berries round, loose, soft, and juicy, of agreeable but not marked flavor, and with green, thin, but rather resistant skin. The must showed 21.5% of solid contents by spindle and 0.58% of acid. In five days the wine was nearly dry, the highest temperature of 82.5° being reached on the third day.

On the fifth day the wine was racked off, but left in the fermenting-room, as it was not quite dry. At one month it was still cloudy, but tasted sound, though somewhat insipid. At two months it was racked again and taken to the cellar. At four months the wine was still cloudy, insipid, and of poor quality, but without any very bad taste. The lees, however, showed some germs of unsoundness, and two months later, as the flavor was becoming affected, the wine was pasteurized. At nine months the wine was bright and much improved, but neither the odor nor the taste was quite clean. Two months later it was still in good condition, but was a wine of poor quality. After this it deteriorated.

No. 1130. *Sauvignon vert*, from J. T. Doyle, Cupertino. Received October 3, 1889, in good condition. The bunches were large and rather loose, well shouldered; berries unequal, but in general over-average, soft and very juicy, and with characteristic flavor. The must showed 23.3% of solid contents by spindle and 0.38% of acid.

At six weeks, when the wine was racked for the second time and taken to the cellar, it was nearly clear, of marked flavor and aroma, medium acid, good body, and clean taste. Two months later it was clear, smooth, and agreeable. At this time the lees showed a few unsound germs, and four months later the number had increased and the flavor was beginning to be affected, so the wine was pasteurized. A month after pasteurizing the wine was clear, and but little changed since the last tasting. Two months later it was bright, with good, full bouquet and flavor, clean taste, and in general much improved. At fifteen months it was bright and of good bouquet and flavor, but tasted a little exhausted. At eighteen months the wine bottled at ten months was tasted; it was sound and bright, and fresher and better than the wine in the keg. At this time the rest of the wine was bottled. At two years and five months both samples tasted somewhat thin. A year later the second bottling was smooth, full-bodied, and agreeable, but was lacking in bouquet.

No. 1220. *Sauvignon vert*, from Margherita Vineyard, Fresno. A sample for must analysis was received August 25, 1890, in good condition, but overripe. The must showed 23.7% of solid contents by spindle.

No. 1275. *Sauvignon vert*, from J. T. Doyle, Cupertino. Received October 2, 1890. Bunches and berries large; grapes juicy, wet from the rain, and slightly moldy. Must showed 19.3% of solid contents by spindle. The fermentation was cool and somewhat prolonged, attained a maximum temperature of 79° on the fourth day, and was nearly through eight days after crushing.

The wine was racked twice before the end of the year, cleared well, and developed some bouquet and flavor. At the end of January the lees showed a few unsound germs, and the wine was pasteurized for safety. The wine developed fairly well, acquired a good bouquet, but was somewhat deficient in flavor. At fourteen months the wine tasted mature, and some of it was bottled; at twenty-four months the rest was bottled. One year after bottling the wine was bright and in good order, but that last bottled was a little exhausted.

No. 1433. *Sauvignon vert*, from Tulare station. Received August 27, 1891, in good condition. A sample for must analysis showed 20.85% of solid contents by spindle.

No. 1455. *Sauvignon vert*, from Fresno. Received August 31, 1891, in good condition. The must showed 21.5% of solid contents by spindle. Fermentation lasted six days, attaining a maximum temperature of 80° on the fifth day.

The wine was racked at one and at four months from crushing; cleared rather slowly, but remained sound and developed some bouquet. At eight months the wine was not quite clear, showed some lactic germs in the lees, and did not taste quite clean; it was racked into a sulphured keg, and two months later was racked again. At two years the wine was bright and sound, but with little flavor and a slight taste of sulphur.

No. 1513. *Sauvignon vert*, from P. R. Schmidt, Calistoga. Received September 29, 1891, in good condition, and mature. The must showed 24.25% of solid contents by spindle. Fermentation was very slow and cool, and the wine was not dry till about one month after crushing.

The wine was clear at two months, and was racked at three months for the second time; it had high acid and was at first very harsh, but at five months the bouquet had developed remarkably. At fifteen months it was a fresh and pleasing wine, in first-rate condition, and mature, and was bottled.

No. 1514. *Sauvignon vert*, from Asti, Sonoma County. Received October 1, 1891, in poor condition—crushed and a little moldy. The grapes had none of the flavor of Sauvignon vert, and more resembled Orleans Riesling. The must showed 22.70% of solid contents by spindle. Fermentation was at its height on the fourth day, with a temperature of 77°, and was finished on the eighth day.

The wine was racked twice during the first three months; it cleared well, and gave promise of being a good wine. At five months it was bright, with rich bouquet and flavor, but somewhat raw. At fifteen months it had toned down, was mature, and of high quality. At sixteen months it was bottled.

No. 1540. *Sauvignon vert*, from Paso Robles station. A sample for must analysis was received October 8, 1891, in good condition; grapes mature, but sunburned. The must showed 25.55% of solid contents by spindle.

No. 1669. *Sauvignon vert*, from Tulare station. Received September 19, 1892, in good condition. The must showed 25.45% of solid contents by spindle. For fermentation record, see No. 1668, Semillon.

No. 1773. *Sauvignon vert*, from Paso Robles station. Sample for must analysis was received October 13, 1892, in good condition. The must showed 23.7% of solid contents by spindle.

No. 1821. *Sauvignon vert*, from Amador station. Received September 8, 1893. Fine, juicy grapes, but without much flavor. The must showed 22.6% of solid contents by spindle. The fermentation was very slow and protracted, and the wine was not in sufficient quantity to keep.

No. 1847. *Sauvignon vert*, from Tulare station. Received September 15, 1893. Bunches loose, but well filled, and of average size; the berries were of average size, mature, and well flavored. The must showed 23.7% of solid contents by spindle. The fermentation was prompt and thorough, attaining a maximum temperature of 83° on the second day, and finishing on the sixth day.

The wine cleared rapidly, and at three months, having been racked twice, was bright. At four months it showed marked bouquet and flavor, a slight bitterness, and more character than most of the Tulare wines. At seven months it still showed good qualities, but was not perfectly clean-tasting and fresh.

No. 1961. *Sauvignon vert*, from Paso Robles station. A sample for must analysis was received October 14, 1893, in fair condition. Bunches were of medium size, and winged; berries thin-skinned, juicy, highly flavored, and mature. The must showed 29.3% of solid contents by spindle.

No. 2091. *Sauvignon vert*, from J. T. Doyle, Cupertino. A sample for must analysis was received November 6, 1893, in good condition. Bunches large, shouldered, a little coulured above; berries of medium size, soft, juicy, mature. The must showed 24.1% of solid contents by spindle.

FOLLE BLANCHE.

(See Vit. Rept. 1883-85, p. 124; 1885-86, p. 93.)

Synonyms: Enrageat; Plant de Dame; Grosse Chalosse; Grais; Rebauche in the southwest of France, and Piquepouille in the Department of Gers.

The Folle blanche is too well known at this time in its capacity of a brandy grape, and its wine as a blend for Bordeaux Clarets, to require more than a passing notice here. As a prolific bearer it has attracted considerable attention, but it should not be forgotten that the use of its wine for blending is practically limited by the amount of blendable red wines—that is, wines having sufficient character and color to stand the dilution of these qualities without the addition of something more definite than is supplied by the Folle blanche. The inverse ratio between quality and quantity cannot be too fully remembered, and unless the practice of reducing all wines to a common level, and paying so much per gallon of "wine" to the producer, be supposed to be perpetuated, the world's habit of paying mainly for high quality in wines must be conformed to. It seems predicable of the Folle blanche that it will yield a better quality of blending wine on valley land than either the Sultana or Burger, in the more northern regions of California.

Description.—Trunk short and thick; canes short, thick, of a reddish color, with internodes of medium length; leaves of medium size, five-lobed, petiolar sinus very slightly open, lateral sinus deep and open, teeth short and obtuse, superior surface deep green, glabrous, slightly puckered, the red veins of the inferior surface slightly pubescent; bunch large, compact, cylindrical or conico-cylindrical; berries large, spherical, of a whitish-green, acquiring a golden hue on the side exposed to the sun, skin thick, resistant, juicy, and sweet. Ripens about the second period of Pulliat.

The Folle blanche is the variety *par excellence* of the Charentes or Cognac region of France, where it constitutes nine tenths of the vines grown there. Its wine is very acid, and has little value for direct consumption, being all made into brandy. It is valuable, however, as a blend with the highly colored wines of the "Midi," communicating to them a pleasing freshness and remarkable brilliancy. This is especially true with regard to the Jaquez or Lenoir. It is planted also in considerable quantities in the "Graves" region with the high class of grapes of this type for the production of inferior Sauternes. It adapts itself to all kinds of rich soils. It is subject to spring frosts, and rots easily in wet years.

Wherever the Folle blanche has been tried in California it has usually supported its European reputation as a heavy bearer. Its average for three years at Cupertino was 4.6 tons per acre; about Stockton it gives good crops, but at Tulare the yield has been small. It yields a must characterized in general by low sugar and high acid, and is useful as a blend with certain red grapes to reduce their harshness and to aid their fermentation. From Livermore it is reported as making a good wine, but, in general, it is found to yield only a neutral wine of little character, good for certain blends, and, as in France, particularly suited for the production of brandy. At Tulare it produces an agreeable wine, which matures quickly and must be used young, as it soon deteriorates.

Table of Production.

FOLLE BLANCHE.	Number of Vines	Total Weight of Grapes, in lbs.	Average per Vine, in lbs.	Date of Picking
1887—No. 762 (long-pruned). J. T. Doyle, Cupertino	20	282	14.1	Oct. 20
No. 763 (short-pruned). J. T. Doyle, Cupertino	20	40	2.0	Oct. 20
1888—No. 937 (short-pruned). J. T. Doyle, Cupertino	20	295	14.7	Oct. 23
No. 938 (long-pruned). J. T. Doyle, Cupertino	20	465	23.2	Oct. 23
1889—No. 1167 (short-pruned). J. T. Doyle, Cupertino	19	300	15.2	Oct. 11
Row 82 (short-pruned). J. T. Doyle, Cupertino	20	200	10.0	Oct. 23

ANALYSES OF MUSTS AND WINES.

FOLLE BLANCHE.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Volatile Acid	Body	Ash
1884—No. 258. Natoma Wine Company, Natoma		22.10	21.97	.66	.27	9.92	12.36	.59		1.66	.21
No. 259. J. L. Black, Livermore		18.00		.47		7.43	8.75	.57		1.80	.24
No. 259*a*. Fresno		20.70	20.17	.59	.23						
1886—No. 515. J. T. Doyle, Cupertino		20.00	19.96	.47	.39	6.55	8.23	.69		1.80	
No. 574 (condensed must). J. D. Cone, Sacramento		23.70	24.12	.48	.36						
1887—No. 762 (long-pruned). J. T. Doyle, Cupertino	Oct. 20	23.23	22.23	.71	.35	8.91	11.09	.61	.10	2.20	
No. 763 (short-pruned). J. T. Doyle, Cupertino	Oct. 20	25.14	24.64	.58	.37	10.54	13.00	.50		2.60	
1888—No. 937 (short-pruned). J. T. Doyle, Cupertino	Oct. 23	21.89	22.67	.51	.30	8.48	10.58	.54		2.05	
No. 938 (long-pruned). J. T. Doyle, Cupertino	Oct. 23	21.41	21.80	.68	.26						
1889—No. 1167. J. T. Doyle, Cupertino	Oct. 11	21.95	22.22	.54	.29	8.91	11.09	.44		1.95	
No. 1183. J. Gallegos, Mission San José	Oct. 15	22.60		.44							
1890—No. 1272. J. T. Doyle, Cupertino	Sept. 29	18.15		.76	.24	7.09	8.85	.53		2.44	
No. 1421. J. Gallegos, Mission San José	Oct. 29	26.10		.71							
1891—No. 1452. Tulare	Aug. 26	18.60		.61							
No. 1482. Fresno	Sept. 7	20.65	20.00	.46	.54	8.48	10.58	.38		2.34	
No. 1534. Paso Robles	Oct. 6	18.10		.70							
1892—No. 1672. Tulare	Sept. 16	23.80	23.13	.45	.45	9.20	11.45	.41		2.70	
No. 1752. Paso Robles	Oct. 11	19.85		.60							
1893—No. 1837. Amador station	Sept. 5	19.30		.92							
No. 1860. Amador station	Sept. 12	19.30		.90							
No. 1909. Tulare	Oct. 3	21.50	20.61	.68	.42	8.13	10.17	.59		2.10	
No. 1992. Mission San José	Oct. 19	21.50		.53							
No. 2020. Mission San José	Oct. 27	20.50	19.82	.80	.23	8.27	10.36	.77		2.20	
No. 2032. J. T. Doyle, Cupertino	Oct. 31	23.05		.77							
1894—No. 2244. Mission San José	Oct 5	20.00		.49							
No. 2297. Mission San José	Oct. 12	19.40		.71							
No. 2329. Tulare	Oct. 15	22.60		.45							

RECORD OF TREATMENT.

No. 762. *Folle blanche*, from J. T. Doyle, Cupertino. Received October 21, 1887, in very good condition. The grapes were from long-pruned vines, and showed very little coulure or dried berries. The berries were, on the average, of medium size, but very uneven. The must showed 23.23% of solid contents by spindle and 0.71% of acid. The temperature of the grapes at crushing was 73°, and the maximum reached was 81°, on the third day. The fermentation was over on the fifth day.

At three weeks the wine was drawn off the thick lees. At two months it was clear, with light aroma and full acid; it was sound, but thin. Four months later it was racked again, and pasteurized. At eight months it was bright, and developed a good aroma, and was agreeable, but of rather sharp acidity.

No. 763. *Folle blanche*, from J. T. Doyle, Cupertino. Received October 21, 1887, in good condition. The grapes were from short-pruned vines, and showed more coulure and dried berries than those from the long-pruned vines. The sound berries were, however, larger and sweeter. The must showed 25.14% of solid contents by spindle and 0.58% of acid. The temperature of the grapes at crushing was 73°, and the maximum reached was 80°, on the third day. In eight days the fermentation was over.

At two weeks the wine was drawn off the lees. At two months the wine was light and neutral, with some aroma and pleasant acid. At eight months it was almost bright, well developed, of good body, pleasing acid, and some bouquet.

Nos. 937 and 938. *Folle blanche*, from J. T. Doyle, Cupertino. Received October 24, 1888, in fair condition. The must showed 21.89% of solid contents by spindle and 0.51% of acid in No. 937, and 21.41% of solid contents by spindle and 0.68% of acid in No. 938. The temperature of the grapes at crushing was 71°, and the maximum reached was 85°, on the fourth day. In twelve days the fermentation was over.

At six weeks the wine was racked and taken to the cellar. A month later it was nearly clear and of fair quality, but the lees showed faint traces of unsound germs, so the wine was pasteurized. At six months it was racked again, and at ten months it was clear, well developed, and agreeable. Four months later it showed some improvement. At sixteen months the lees were examined, and no unsound germs found; the wine was bright, with good flavor and well-developed bouquet—altogether a good wine, and mature. A month later it was racked and a part put in bottle. At twenty-one months the wine was in good order, somewhat thin, but of good flavor and bouquet. At twenty-two months it was bottled. At two years and five months the wine first bottled was clear and had made no deposit; it showed good bouquet and flavor, but was not quite clean-tasting. That bottled later was cleaner-tasting, but had less flavor. Eighteen months later the second bottling was still the better.

No. 1167. *Folle blanche*, from J. T. Doyle, Cupertino. Received October 15, 1889, in bad condition, many of the grapes being moldy. The must showed 21.95% of solid contents by spindle and 0.54% of acid. The maximum temperature reached was 82°, and the fermentation was over on the sixth day. In two months the wine was clear, of very light color, faint but agreeable aroma, clean-tasting. of medium body and full acidity, and, in general, rather good. A month later it was bright and well developed, but neutral. The lees were sound, but at seven months they showed some bitter ferments, and, though the taste was unaffected, the wine was pasteurized for safety. A month after pasteurizing the wine was bright, of delicate bouquet, good flavor, full and pleasing acid, and advanced development. The lees, which were examined twice after this, remained sound. At fifteen months the wine was in good condition—smooth, pleasing, and mature. Two months later it was racked, and at twenty-two months bottled. At two years and five months the wine was bright, very smooth, and pleasing, with little character, but no positive defects. A year later it had retained its good qualities, and had made a very little deposit in the bottle.

No. 1183. *Folle blanche*, from Mission San José. A sample for must analysis was received October 16, 1889, in fair condition, and mature; soft, juicy grapes, with somewhat thick and tough skin and insipid taste. The must showed 22.6% of solid contents by spindle.

No. 1272. *Folle blanche*, from J. T. Doyle, Cupertino. Received October 2, 1890, in bad condition—much bruised and with many moldy and rotten bunches. The grapes, which were not mature, were carefully picked over and fermented. The must showed 18.15% of solid contents by spindle. The fermentation lasted a week, and reached a maximum temperature of 80° on the fourth day.

The wine was slow in clearing, but at two months was clear, light, highly acid, clean-tasting, but lacking in bouquet and flavor. At three months the wine was much improved, having acquired some bouquet. At five months the wine showed some unsound germs in the lees, and was therefore pasteurized. The wine was green, but continued improving until it was fifteen months old, when part of it was bottled; the rest was bottled five months later. Fourteen months after bottling the wine was bright, of fair quality, lacking in bouquet, but of good flavor. That bottled later was somewhat exhausted, and inferior to the others.

No. 1421. *Folle blanche*, from J. Gallegos, Mission San José. A sample, for must analysis only, arrived October 31, 1890. The must showed 26.1% of solid contents by spindle.

No. 1452. *Folle blanche*, from Tulare station. A sample for must analysis was received August 29, 1891, in good condition, but not mature. The must showed 18.6% of solid contents by spindle.

No. 1482. *Folle blanche*, from H. Eggers, Fresno. Received September 9, 1891, somewhat injured from loose packing and a little moldy, not quite mature. The must, which showed 20.65% of solid contents by spindle, fermented through in six days.

The wine was at first slow in clearing, green, and without bouquet, but well flavored, smooth, and agreeable. It was racked twice during the first three months, and three times afterward; it remained green-tasting, but improved, and at six months was a light, neutral, fairly agreeable wine. After that it deteriorated somewhat. At eighteen months it was bottled, and but for a somewhat disagreeable odor was a fair wine.

No. 1534. *Folle blanche*, from Paso Robles station. A sample for must analysis was received October 8, 1891, in good condition, but not quite mature. Bunches were medium-sized, very compact, with small berries. The must showed 18.10% of solid contents by spindle.

No. 1672. *Folle blanche*, from Tulare station. Received September 19, 1892; a little crushed, but fresh. The must showed 23.8% of solid contents by spindle; it fermented well, attaining the maximum temperature of 80° on the third day after crushing.

The wine was racked twice during the first three months, cleared well, and as a young wine was very promising. At seven months it was at its best, in good condition, smooth and of good body, but lacking in flavor and bouquet. At fourteen months it was bright and sound, but a little flat and lacking in "finesse."

No. 1752. *Folle blanche*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. Solid contents by spindle, 19.85%.

No. 1837. *Folle blanche*, from Amador station. A sample for must analysis was received September 8, 1893, in good condition. Bunches and berries medium-sized; grapes not mature. The must showed 19.3% of solid contents by spindle.

No. 1860. *Folle blanche*, from Amador station. Received September 15, 1893, in good condition. The same as No. 1837, showing about the same degree of maturity.

No. 1909. *Folle blanche*, from Tulare station. Received October 5, 1893, in good condition. Large, juicy berries, in medium-sized bunches, mature, but with little flavor. The must showed 21.5% of solid contents by spindle. The fermentation was prompt and thorough, attaining its maximum, with a temperature of 82°, on the third day, and finishing on the third day.

The wine cleared rapidly, and was racked twice during the first month. At three months it was bright, had a little bouquet, some flavor, and good acid. At six months it had not changed much, but was a fairly fresh-tasting wine, without much character.

No. 1992. *Folle blanche*, from Mission San José. A sample for must analysis was received October 19, 1893, in good condition. The grapes were medium-sized, fleshy, thin-skinned, and quite mature. The must showed 21.5% of solid contents by spindle.

No. 2020. *Folle blanche*, from Mission San José. Received October 27, 1893, in poor condition—crushed, and with some mold. The must showed 20.5% of solid contents by spindle. The fermentation was slow and cool, and three weeks after crushing the wine contained a little sugar.

At three months the wine was bright, dry, and clean-tasting, with little bouquet, but distinctive flavor and full acid. At six months it was a good, clean-tasting wine, but with rather high and crude acid.

No. 2032. *Folle blanche*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 31, 1893, in good condition. The berries were rather large, juicy, and thick-skinned, in medium-sized bunches; they were mature, and commencing to rot. The must showed 23.05% of solid contents by spindle.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF SAUTERNE TYPE.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at 6 to 8 Months	Body
	Semillon.								
106	Glen Ellen	1883	------	------	------	------	10.58	.38	1.52
339	Lower Lake	1885	22.89	------	.55	.32	------	------	------
434	San José	1885	------	------	------	------	13.00	.51	1.80
251	Natoma	1884	18.83	18.89	.54	.28	------	------	------
252	Natoma	1884	21.69	20.99	.42	.28	12.36	.45	1.93
502	Cupertino	1886	18.40	18.29	.57	.23	8.93	.69	------
745	Cupertino. (Long-pruned)	1887	24.89	24.12	.50	.40	12.54	.52	2.80
750	Cupertino. (Long-pruned)	1887	24.04	22.23	.54	.43	11.36	.47	2.60
753	Cupertino. (Short-pruned)	1887	25.26	25.53	.44	.45	12.82	.66	2.10
899	Cupertino. (Short-pruned)	1888	23.54	24.34	.34	.41	11.45	.54	2.60
900	Cupertino. (Long-pruned)	1888	22.81	22.85	.34	.42	11.27	.44	2.35
1131	Cupertino	1889	24.10	24.64	.41	.27	------	------	------
1329	Cupertino	1890	23.70	------	.57	------	------	------	------
2030	Cupertino	1893	24.55	------	.60	------	------	------	------
1015	Fresno	1889	26.90	26.99	.31	.60	------	------	------
1216	Fresno	1890	25.90	24.10	.32	.35	------	------	------
1556	Paso Robles	1891	26.90	------	.38	------	------	------	------
1648	Paso Robles	1892	22.15	------	.51	------	------	------	------
1739	Paso Robles	1892	25.50	------	.39	------	------	------	------
1668	Tulare	1892	24.00	24.64	.36	.45	12.54	.59	3.30
1798	Tulare	1893	21.50	20.24	.50	.28	9.50	.50	------
2155	Tulare	1894	25.20	------	.35	------	------	------	------
1657	Amador station	1892	23.65	------	.48	------	------	------	------
1818	Amador station	1893	20.90	19.89	.63	.28	------	------	------
2158	Amador station	1894	26.90	------	.38	------	------	------	------
	Average, Natoma	------	**20.26**	**19.94**	**.48**	**.28**	**12.36**	**.45**	**1.93**
	Average, Cupertino	------	**23.47**	**23.14**	**.36**	**.37**	**11.39**	**.55**	**2.07**
	Average, Fresno	------	**26.40**	**25.55**	**.31**	**.47**	------	------	------
	Average, Paso Robles	------	**23.82**	------	**.40**	------	------	------	------
	Average, Tulare	------	**23.56**	**22.44**	**.40**	**.26**	**11.02**	**.59**	**3.30**
	Average, Amador station	------	**22.52**	**19.89**	**.49**	**.28**	------	------	------
	Sauvignon blanc.								
253	Natoma	1884	21.66	21.22	.62	.31	12.75	.55	2.18
254	Natoma	1884	22.20	20.99	.53	.29	12.36	.45	2.10
335	Lower Lake	1885	24.20	------	.59	------	------	------	------
1032	Fresno	1889	23.76	23.61	.79	.60	------	------	------
1464	Fresno	1891	23.50	22.95	.76	.46	11.00	.53	2.74
1134	Cupertino	1889	26.10	26.12	.58	.37	------	------	------
1317	Cupertino	1890	25.00	------	.58	.20	15.20	.48	2.12
2325	Tulare	1894	24.50	------	.35	------	------	------	------
	Average, Natoma	------	**21.93**	**21.15**	**.57**	**.30**	**12.55**	**.50**	**2.14**
	Average, Fresno	------	**23.63**	**23.28**	**.77**	**.53**	**11.00**	**.53**	**2.74**
	Average, Cupertino	------	**25.55**	**26.12**	**.58**	**.28**	**15.20**	**.48**	**2.12**
	Sauvignon vert.								
724	Livermore	1887	22.67	22.67	.30	.42	11.82	.47	2.60
1513	Calistoga	1891	24.25	21.38	.53	.35	13.09	.53	2.20
1514	Asti, Sonoma County	1891	22.70	21.38	.44	.30	11.45	.53	2.55
490	Cupertino	1886	18.70	18.71	.42	.26	8.85	.53	1.75
697	Cupertino. (Long-pruned)	1887	23.01	23.23	.39	.34	12.00	.75	2.20
708	Cupertino. (Short-pruned)	1887	25.67	26.00	.47	.54	13.45	.44	2.60
880	Cupertino. (Short-pruned)	1888	21.39	21.38	.28	.40	9.90	.45	2.33
881	Cupertino. (Long-pruned)	1888	21.55	22.23	.27	.24			
1130	Cupertino	1889	23.30	22.95	.38	.39	11.91	.40	2.40
1275	Cupertino	1890	19.30	------	.51	.24	10.25	.42	2.20
2091	Cupertino	1893	24.10	------	.61	------	------	------	------
1018	Fresno	1889	24.50	25.19	.46	.66	------	------	------
1095	Fresno	1889	21.50	21.38	.58	.48	11.00	.47	2.70
1220	Fresno	1890	23.70	23.61	.47	.45	------	------	------

Summary of Analyses of Musts and Wines of Sauterne Type—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at 6 to 8 Months	Body
	Sauvignon vert—Continued.								
1455	Fresno	1891	21.50	------	.68	------	11.09	.49	2.60
1433	Tulare	1891	20.85	------	.30	.61	------	------	------
1669	Tulare	1892	25.45	25.53	.37	.49	------	------	------
1847	Tulare	1893	23.70	21.80	.54	.51	11.45	.44	2.60
2287	Tulare	1894	26.90	25.19	.38	------	12.82	.41	2.30
1540	Paso Robles	1891	25.55	------	.22	------	------	------	------
1733	Paso Robles	1892	23.70	------	.35	------	------	------	------
1961	Paso Robles	1893	29.30	------	.32	------	------	------	------
2218	Paso Robles	1894	25.65	------	.30	------	------	------	------
1821	Amador station	1893	22.60	21.38	.59	.21	------	------	------
2157	Amador station	1894	26.90	------	.38	------	------	------	------
	Average, Cupertino	------	**22.12**	**22.41**	**.41**	**.34**	**11.04**	**.50**	**2.24**
	Average, Fresno	------	**22.55**	**23.39**	**.54**	**.53**	**11.04**	**.48**	**2.65**
	Average, Tulare	------	**24.22**	**24.57**	**.40**	**.53**	**12.13**	**.42**	**2.45**
	Average, Paso Robles	------	**26.05**	------	**.30**	------	------	------	------
	Average, Amador station	------	**24.75**	**21.38**	**.48**	**.21**	------	------	------
	Folle blanche.								
258	Natoma	1884	22.10	21.97	.66	.27	12.36	.59	1.66
259	Livermore	1884	18.00	------	.47	------	8.75	.57	1.80
259*a*	Fresno	1884	20.70	20.17	.59	.23	------	------	------
1482	Fresno	1891	20.65	20.00	.46	.54	10.58	.38	2.34
574	Sacramento (condensed must)	1886	23.70	24.12	.48	.36	------	------	------
515	Cupertino	1886	20.00	19.96	.47	.39	8.23	.69	1.80
762	Cupertino. (Long-pruned)	1887	23.23	22.23	.71	.35	11.09	.61	2.20
763	Cupertino. (Short-pruned)	1887	25.14	24.64	.58	.37	13.00	.50	2.60
937	Cupertino. (Short-pruned)	1888	21.89	22.67	.51	.30	10.58	.54	2.05
938	Cupertino. (Long-pruned)	1888	21.41	21.80	.68	.26			
1167	Cupertino	1889	21.95	22.22	.54	.29	11.09	.44	1.95
1272	Cupertino	1890	18.15	------	.76	.24	8.85	.53	2.44
2032	Cupertino	1893	23.05	------	.77	------	------	------	------
1183	Mission San José	1889	22.60	------	.44	------	------	------	------
1421	Mission San José	1890	26.10	------	.71	------	------	------	------
1992	Mission San José	1893	21.50	------	.53	------	------	------	------
2020	Mission San José	1893	20.50	19.82	.80	.23	10.36	.77	2.20
2244	Mission San José	1894	20.00	------	.49	------	------	------	------
2297	Mission San José	1894	19.40	------	.71	------	------	------	------
1837	Amador station	1893	19.30	------	.92	------	------	------	------
1860	Amador station	1893	19.30	------	.90	------	------	------	------
1452	Tulare	1891	18.60	------	.61	------	------	------	------
1672	Tulare	1892	23.80	23.13	.45	.45	11.45	.44	2.70
1909	Tulare	1893	21.50	20.61	.68	.42	10.17	.59	2.10
2329	Tulare	1894	22.60	------	.45	------	------	------	------
1534	Paso Robles	1891	18.10	------	.70	------	------	------	------
1752	Paso Robles	------	19.85	------	.60	------	------	------	------
	Average, Fresno	------	**20.65**	**20.08**	**.52**	**.38**	**10.58**	**.38**	**2.34**
	Average, Cupertino	------	**21.85**	**22.25**	**.62**	**.31**	**10.47**	**.55**	**2.17**
	Average, Mission San Jose	------	**21.68**	**19.82**	**.61**	**.23**	**10.36**	**.77**	**2.20**
	Average, Amador station	------	**19.30**	------	**.91**	------	------	------	------
	Average, Tulare	------	**21.62**	**21.87**	**.54**	**.43**	**10.81**	**.51**	**2.40**
	Average, Paso Robles	------	**18.92**	------	**.65**	------	------	------	------

WHITE SOUTHERN FRENCH TYPE.

Properly speaking, there is no well-marked type of Southern French white wine. Few white wines are made in the "Midi," especially since the advent of the phylloxera, and of these only the dessert wines, sweet wines, and "vins de liqueur" have any extended reputation. The white grapes are generally used in small quantities with red grapes, to give smoothness and delicacy to the red wines. Few of the varieties of this group are promising for the production of white wines in California. From the Marsanne some good wines have been made, which can be used with advantage, where it succeeds well, as a blend with white grapes of more pronounced character. Some good wine has also been made from the Chauché gris, but the difficulty of handling the grapes and wine of this variety very much detract from its desirability. The Clairette blanche, which is shipped in such large quantities to Paris as a late table-grape, may find a like use here; it makes a high-class, delicately flavored wine. It is a very vigorous grower and a fairly heavy bearer, if its tendency to coulure can be overcome. This can, perhaps, be done by giving the vine a large development, instead of pruning it back to a close head.

CLAIRETTE BLANCHE.

(See Vit. Rept. 1883–85, p. 128; 1885–87, p. 96.)

Synonyms: Blanquette; Petit blanc.

Description.—Vine vigorous, with long, erect canes with rather short internodes; leaves of medium size, circular in outline, and with shallow sinuses, upper surface very dark green, cobwebby when young, becoming glabrous with age, lower surface thickly covered with a white down; bunches over medium in size, conical, heavily shouldered, close when not coulured; berries under medium in size, ovoid, white, crisp, juicy, and covered with bloom.

The Clairette blanche belongs altogether to southern France, within the region of olive culture; from below Valence, on the Rhone, to the Mediterranean coast, and along the same from Nice to the Spanish frontier. Within this region it has been extensively cultivated from ancient times to the present. It is used, not only to impart delicacy and spirit to red wines, but also by itself produces the wine commercially known as Picardan, as well as others locally designated as "Clairette." It is used for both dry and sweet wines. For the latter it is allowed to become overripe and shriveled on the vines. It is, besides, highly esteemed as a table-grape. It bears transportation well, and keeps well during the winter, being firm-fleshed; is crisp, sweet, and agreeably flavored.

The hardiness and vigorous growth of the Clairette are proverbial in southern France. No variety is longer-lived; it gives good crops even when old, and has resisted, longer than any other southern variety, the attacks of the phylloxera. It adapts itself readily to all soils, provided they are deep; on shallow, stony ground it is soon exhausted.

Some details regarding its growth and habit when grafted, as observed at Mission San José by Prof. Hilgard (Vit. Rept. 1885-86), are of sufficient interest to find a place here:

> The cuttings had become somewhat dry while waiting for favorable weather or for grafting, and considering this fact they showed a remarkable vitality. The grafts were made about two thirds on *Californica* stock, then in its third year from the planting of the seedling; the stocks ranged from three fourths to one and one fourth inches, and only one graft, as a rule, was put on each. The other third was put on *Riparia* and *Rupestris* stocks, varying, the first from one half to three fourths of an inch, the second rarely reaching one half inch; both being from the cutting, of the same age as the *Californica*.
>
> Of the grafts put on *Californica*, about 88% grew; of those on *Riparia*, about 50%; of those on *Rupestris*, about 20%. Only the *Californica* stock even remotely kept pace with the growth of the grafts themselves, which pushed with such vigor that it was very difficult to keep their branches from being wrenched off by the wind before being tied. This brittleness of the wood must be well kept in view in handling this vine, which needs strong stakes at least 30 inches high above ground, and somewhat elaborate tying-up, to prevent its being wrenched off by the overweight of the top, above any low-tied withe or rope. Of the *Rupestris* and *Riparia* grafts, few were thus injured, because of the flexibility of the thin stock; but, owing to the disproportion in the size of stock and scion, many of the grafts sent out vigorous roots and continued doing so after the removal of one set; showing clearly that these two stocks are (at least on the strong adobe of the Mission hills) quite inadequate to the demands of so vigorous a grower as the Clairette.
>
> All the grafts on *Californica* and many of those on *Riparia* bloomed profusely, and the majority set a fair proportion of berries, some bunches being almost without coulure; although, owing to the lateness of the bloom, the hot sunshine, and the violent winds, a great deal of coulure was naturally looked for, and in some cases made whole bunches fail entirely.

The Clairette is used in France for making wines of very diverse character; in the Department of Hérault it makes a good dry, white wine; in Var and Drôme it is used for the production of sparkling wines; in other localities a dry wine resembling Madeira is obtained from it; in others, a sweet wine with a strong "rancio" taste; while in many others it is used in small quantities as an addition to red wines.

It is best suited to a strong, clayey, well-drained soil, and is one of the best grapes to plant in a shady place. It is equally suited to either long or short pruning. Wherever planted in California it has proved itself a vigorous grower, with abundant and healthy foliage, and is resistant to diseases with the exception of coulure; though in France it is said to be peculiarly susceptible to the *Anthracnose ponctuée.* In the coast counties it has proved itself an unreliable bearer, sometimes giving good crops, but oftener badly damaged by coulure. In Tulare it has borne fairly well, and at the Foothill Station, in Amador County, it has been one of the best bearers among the white grapes. The average composition of the must has been: at Tulare, 24.3% of sugar and 0.35% of acid; at the Amador Station, 22.5% of sugar and 0.47% of acid; at Paso Robles, 23.5% of sugar and 0.39% of acid; at Mission San José, 22.0% of sugar and 0.55% of acid; at Cupertino, 20.6% of sugar and 0.46% of acid. In general, the wine has been of good quality, but not a good keeper. The best results, so far, have been from Tulare, where it makes a wine of rather more character and freshness than most of the other white grapes tried there; it also seems promising for Amador County. It ripens at the end of September in Amador County and the middle of October in Tulare; it resists the weather well, and can hang for a long time on the vines without damage.

ANALYSES OF MUSTS AND WINES.

CLAIRETTE BLANCHE.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six to Eight Months	Volatile Acid	Body	Ash
						By Weight	By Volume				
1884—No. 264. Natoma Wine Co., Natoma	------	21.34	21.07	.45	.31	10.54	13.00	.43	------	1.85	.21
1886—No. 481. J. Gallegos, Mission San José	------	17.50	17.22	.53	.28	7.09	8.85	.55	------	2.10	------
No. 510. E. W. Hilgard, Mission San José	------	20.00	------	.87	------	------	------	------	------	------	------
No. 513. F. Pohndorff, Jr., Mission San José	------	19.30	------	.56	------	6.89	8.61	.47	------	1.58	------
No. 535. E. W. Hilgard, Mission San José	------	21.50	20.76	.86	.36	7.99	10.00	.51	------	1.80	------
No. 535*a*.* E. W. Hilgard, Mission San José	------	21.50	20.76	.86	.36	7.85	9.82	.57	------	1.92	------
1887—No. 771. E. W. Hilgard, Mission San José	Oct. 21	25.45	25.20	.45	.35	9.92	12.36	.61	.14	2.20	------
1888—No. 948. E. W. Hilgard, Mission San José	Oct. 26	23.32	22.22	.26	.28	9.05	11.27	.55	------	1.80	------
1889—No. 1170. J. Gallegos, Mission San José	Oct. 15	22.40	22.67	.41	.35	9.27	11.55	.40	------	2.55	------
No. 1196. J. T. Doyle, Cupertino	Oct. 24	18.15	17.17	.34	.45	6.95	8.70	.42	------	1.35	------
1890—No. 1398. J. T. Doyle, Cupertino	Oct. 18	21.10	------	.53	------	------	------	------	------	------	------
No. 1420. J. Gallegos, Mission San José	Oct. 28	26.30	------	.54	.21	10.81	13.27	.42	------	2.78	------
1891—No. 1543. Paso Robles	Oct. 7	24.80	------	.45	------	------	------	------	------	------	------
1892—No. 1658. Amador station	Sept. 16	22.70	------	.46	------	------	------	------	------	------	------
No. 1701. Tulare	Sept. 27	22.40	------	.29	------	------	------	------	------	------	------
No. 1748. Paso Robles	Oct. 11	22.20	------	.32	------	------	------	------	------	------	------
1893—No. 1838. Amador station	Sept. 5	18.00	------	.71	------	------	------	------	------	------	------
No. 1862. Amador station	Sept. 12	21.70	------	.56	------	------	------	------	------	------	------
No. 1969. Tulare	Oct. 14	22.90	21.38	.38	.30	9.20	11.45	.53	------	2.20	------
No. 2029. Cupertino	Oct. 31	22.40	------	.50	------	------	------	------	------	------	------
No. 2065. Mission San José	Nov. 1	24.80	------	.54	------	------	------	------	------	------	------
1894—No. 2192. Amador station	Sept. 23	24.15	------	.39	------	------	------	------	------	------	------
No. 2225. Mission San José	Oct. 2	20.60	19.21	.62	------	------	------	.64	------	------	------
No. 2339. Tulare	Oct. 17	25.00	------	.34	------	------	------	------	------	------	------
No. 2345. Mission San José	Oct. 22	20.85	------	.39	------	------	------	------	------	------	------

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* Fermented with skins.

RECORD OF TREATMENT.

No. 771. *Clairette blanche*, from E. W. Hilgard, Mission San José. Received October 24, 1887, in fair condition, but rather overripe. The bunches were imperfect, and showed much early coulure. The must showed 25.45% of solid contents by spindle and 0.45% of acid. The temperature of the grapes at crushing was 71°, and the maximum reached was 81°, on the third day. On the eighth day the wine was dry.

At two months the wine was not very well developed and was not of agreeable flavor. The lees showed some secondary ferments, so the wine was pasteurized. Two months later it was bright, and had developed some bouquet, but was not clean-tasting. It was racked for the third time. After this the wine did not change much; it remained bright, but did not develop any good qualities.

No. 948. *Clairette blanche*, from E. W. Hilgard, Mission San José. Received October 29, 1888, in fair condition; many bunches contained dried and half-dried berries. The must showed 23.32% of solid contents by spindle and 0.26% of acid. The temperature of the grapes at the maximum point of fermentation was 90°, and the wine was quite dry on the thirteenth day.

At one month the wine was racked and taken to the cellar. Two months later it was almost clear and of delicate flavor. At five months it was racked again, and the lees were sound. At ten months it showed good quality, but was not well developed. At thirteen months it was quite bright, but not quite clean-tasting. After this it deteriorated steadily, and at two years it was thrown away.

No. 1170. *Clairette blanche*, from E. W. Hilgard, Mission San José. Received October 16, 1889, in good condition, and completely mature. The must showed 22.4% of solid contents by spindle and 0.41% of acid. The temperature reached its maximum of 79° on the third day after crushing. On the fifth day the wine was dry, and was racked off the thick lees.

At two months the wine was clear, of very light color, of peculiar and hardly pleasant flavor, earthy taste, low acid, medium body, and full alcohol. The wine was racked and taken to the cellar. A month later it was much improved in flavor, and had developed a little bouquet. It was racked again in five months. The lees were sound when examined at three and seven months. At eight months the wine was not quite bright, had light but pleasant bouquet, agreeable flavor, still a slight earthy taste, but much improved since January, smoother and more developed. After this the wine gradually deteriorated, and, although it was pasteurized at seventeen months, it was found impossible to keep it longer.

No. 1196. *Clairette blanche*, from J. T. Doyle, Cupertino. Received October 24, 1889, in bad condition. The grapes were crushed, and moldy on account of the rain; they were quite mature, though the must showed only 18.15% of solid contents by spindle and 0.34% of acid. The fermentation reached its maximum on the fourth day at a temperature of 73.5°, and the wine went on fermenting slowly for several days after.

At two weeks the wine was racked. At two months it was clear, but only of fair quality. At this date it was racked again and taken to the cellar. The wine was weak and thin, and a month later it began to show signs of spoiling. It was pasteurized, but its keeping qualities were so bad that it could not be preserved.

No. 1398. *Clairette blanche*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 21, 1890, in fair condition, and mature. The must showed 21.1% of solid contents by spindle.

No. 1420. *Clairette blanche*, from Mission San José. Received October 31, 1890, in fair condition—a few of the grapes moldy and a few dried, mature. The must showed 26.3% of solid contents by spindle. It attained its maximum temperature of 81°, on the fourth day, and on the seventh day was nearly dry.

The wine was racked once during the first five weeks, at the end of which time it was bright, very slightly sweet, with some aroma, a pleasant flavor, low acid, high alcohol, and, in general, of good quality. At three months it was bright, had good bouquet and full characteristic flavor, and was generally improved. At five months it was pasteurized, as it had deteriorated and the lees showed a few lactic filaments. At fourteen months it was bright, possessed a little bouquet and full flavor, and was, in general, a good wine, though somewhat exhausted. At sixteen months it was bottled. At two years after bottling it was an extremely smooth, soft wine and well kept, considering the smallness of the sample made.

No. 1543. *Clairette blanche*, from Paso Robles station. A sample for must analysis arrived October 8, 1891, in good condition, mature; bunches of good size, well filled, but not compact. The must showed 24.8% of solid contents by spindle.

No. 1658. *Clairette blanche*, from Amador station. A sample for must analysis arrived September 19, 1892, in fair condition. The must showed 22.7% of solid contents by spindle.

No. 1701. *Clairette blanche*, from Tulare station. A sample for must analysis was received September 29, 1892, in good condition. The must showed 22.4% of solid contents by spindle.

No. 1748. *Clairette blanche*, from Paso Robles station. A sample for must analysis arrived October 13, 1892, in good condition. The must showed 22.2% of solid contents by spindle.

No. 1838. *Clairette blanche*, from Amador station. A sample for must analysis arrived September 8, 1893, in good condition; both bunches and berries were very small, grapes flavorless and not mature. The must showed 18.0% of solid contents by spindle.

No. 1862. *Clairette blanche*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition; good-sized bunches of medium-sized berries, not quite mature. The must showed 21.7% of solid contents by spindle.

No. 1969. *Clairette blanche*, from Tulare station. Received October 16, 1893, in good condition. The bunches were under medium in size, loose, and irregular; berries varying from small to medium, crisp, and sweet. The must showed 22.9% of solid contents by spindle. The maximum temperature attained was 77°, on the third day, and in six days the must was nearly dry.

A month after crushing the wine had been racked once, and was clear and clean-tasting. At three months it was bright, with a little bouquet, some flavor, and full body; in general, a fair wine. At six months it had been racked three times, was bright and sound, with agreeable acid, and was fresher-tasting than most of the Tulare wines.

No. 2029. *Clairette blanche*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were of medium size, conical, with small wings, loose, but with no coulure; berries of medium size, crisp, juicy, and sweet. The must showed 22.4% of solid contents by spindle.

No. 2065. *Clairette blanche*, from Mission San José. A sample for must analysis was received November 1, 1893, in good condition. The bunches were large, loose, conical, with large wings, some coulure; berries small and pulpy. The must showed 24.8% of solid contents by spindle.

MARSANNE.

(See Vit. Rept. 1883–85, p. 127; 1885–87, p. 96.)

Description.—Vine vigorous; canes strong, with elongated internodes; leaves large, wrinkled, with rather deep lateral and closed petiolar sinuses, teeth short, wide, obtuse, upper surface glabrous, lower sparsely covered with an arachnoid down; bunch rather large, winged, and rather compact; berries of medium size, round, whitish, crisp, and juicy.

In general, the bunches are more compact in California than in France, and in Tulare the grapes acquire the hard, fleshy character distinguishing many of the Sherry varieties. At most of the stations this variety has shown itself a strong grower, with abundant foliage, and a good bearer, even with short-pruning. In Tulare it has done well, except where the alkali is too strong, bearing between four and five tons per acre. In the coast counties it bears from two to five tons per acre. It seems more susceptible to *oidium* in California than in France, and at the Amador station it has suffered from sunburn. At the latter station the vine grows well in red soil, but on a cool, granite soil it has not done so well, producing bunches of small and abortive berries.

It has given satisfaction in parts of Napa, Santa Clara, and San Mateo, but at the stations the grapes have generally been too high in sugar and too low in acid for a good and easily handled dry wine. At Tulare it gives a good, sweet wine of Sherry type, but is a failure for dry wine, having too much body and too little acid. Though not especially to be recommended for use alone, it is an excellent blend for varieties which lack alcoholic strength and body. Professor Husmann finds that it greatly improves either Sauvignon vert or Green Hungarian.

ANALYSES OF MUSTS AND WINES.

MARSANNE.	Date of Picking	MUST.				WINE.				
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six to Eight Months	Body	Sugar
						By Weight	By Volume			
1890—No. 1412. Cupertino	Oct. 29	24.10	------	.66	.27	10.35	12.82	.50	2.50	----
1892—No. 1619. Tulare	Aug. 28	25.65	23.67	.38	.45	18.05*	22.18	.43	3.66	.94
1893—No. 1856. Amador station	Sept. 12	23.70	------	.48	----	------	------	------	------	----
No. 1960. Paso Robles	Oct. 12	24.10	--- -	.24	----	------	------	------	------	----
No. 2000. Tulare	Oct. 22	26.10	25.76	.41	.50	10.27	12.73	.43	2.90	----
No. 2097. Cupertino	Nov. 6	25.90	------	.63	----	------	------	------	------	----
1894—No. 2162. Amador station	Sept. 15	26.70	------	.34	----	------	------	------	------	----
No. 2203. Tulare	Sept. 25	27.35	------	.26	----	------	------	------	------	----

* Fortified.

RECORD OF TREATMENT.

No. 1412. *Marsanne*, from J. T. Doyle, Cupertino. Received October 30, 1890, in fair condition. The grapes had passed maturity, but were not very sweet; some had commenced to rot, all more or less shriveled, but tasting well. The must showed 24.1% of solid contents by spindle. The fermentation reached its maximum on the fourth day, at a temperature of 79°, and continued for seven days, when the wine was nearly dry.

At five weeks the wine had been racked twice, and was clear, of delicate bouquet and flavor, smooth, with medium acid, and generally good. At three months it was bright, of marked and agreeable flavor and good bouquet, and generally improved. Successive tastings during the first year showed a gradual improvement, and at fourteen months the wine was bright, clean-tasting, and of high quality. The wine was bottled, some at sixteen months and some at twenty-four months. The latter bottling did not keep well, but the former at ten months after bottling was bright, smooth, and good, but a little flat.

No. 1619. *Marsanne*, from Tulare station. Received September 1, 1893, in good condition. The must showed 25.65% of solid contents by spindle. The must, having high sugar contents, low acid, and showing signs of not fermenting well, was made into a sweet wine. The fermentation reached its maximum on the third day, at a temperature of 78°, and on the sixth day, while the must was still sweet, it was fortified.

The wine was clear three weeks after crushing, and was racked. At three months it was bright, clean-tasting, with low acid, but with hardly sufficient sweetness. At six months more alcohol and a little sugar were added, and the wine put into a hot chamber at a temperature of 95°, where it remained for three months. At ten months it was bright, of good flavor, and promised to make a good Sherry.

No. 1856. *Marsanne*, from Amador station. A sample for must analysis arrived September 15, 1893, in poor condition, and diseased. Bunches were of medium size, compact; berries small to medium, well colored. The must showed 23.7% of solid contents by spindle.

No. 1960. *Marsanne*, from Paso Robles station. A sample for must analysis was received October 14, 1893, in good condition. Bunches were large, irregular, and loose; berries medium size, round, very hard, and fleshy, not quite mature. The must showed 24.1% of solid contents by spindle.

No. 2000. *Marsanne*, from Tulare station. Received October 23, 1893, in good condition. Bunches were of medium size, short, irregularly cylindrical, sometimes shouldered, close; berries of medium size, with many smaller ones, round, thin-skinned, of pleasant flavor, quite mature, some berries softening and drying up. The must showed 26.1% of solid contents by spindle. The must was dry in five days, the fermentation reaching its height on the third day at a temperature of 83°.

The wine was clear one month after crushing, and was racked twice during the first six weeks. At three months, three weeks after the third racking, it was bright, heavy-bodied, with some flavor and bouquet, but lacking in cleanness of taste and freshness. At six months it was bright and apparently sound, but the odor was not good and the taste slightly bitter.

No. 2097. *Marsanne*, from J. T. Doyle, Cupertino. A sample for must analysis arrived November 6, 1893, in good condition. Bunches were of medium size, irregular, winged or branched, well filled, but with many abortive berries; normal berries, of medium size, round, soft. The must showed 25.9% of solid contents by spindle.

CHASSELAS DORÉ.

(See Vit. Rept. 1885-86, p. 100.)

Synonyms: Chasselas de Fontainebleau; Gutedel; Sweetwater.

There are planted in California many of the innumerable varieties of Chasselas which are known in Europe, but the one which is best known and most extensively planted is the true Chasselas doré of France. All the members of the Chasselas tribe are distinguished by the brownish color of the young shoots and leaves, the round shape of the berries, and the peculiar texture of the skin and the flesh. The description here given is that of the typical Chasselas doré.

Description.—A rather vigorous grower, with medium or somewhat slender canes of a reddish-brown color; young shoots of garnet color, nearly or quite glabrous; leaves rather below average size, a little longer than wide, glabrous above and nearly so below, except for a few hairs on the main nerves, with well-marked sinuses, the petiolar one often closed, the petiole long, rather slender, and rose-colored; bunches of medium or over-medium size, conico-cylindrical, shouldered, more or less compact; berries medium to large, with firm but tender skin, small seeds, of delicate flavor and texture, at first crisp but becoming soft with full maturity. The grapes are of a clear green color, tinged with a beautiful golden bronze where exposed to the sun.

This variety should not be confused with the Listan or Palomino, which goes under the name of Golden Chasselas in Napa County and other localities. The latter is a totally different grape, belongs to the Sherry type, and is in no sense a Chasselas of any kind.

As a table-grape the Chasselas has failed to satisfy the public taste here as it does in France, except to a limited extent as one of the earliest grapes that can be put on the market. It is too delicate to be used for any but the local markets, as it will not bear shipping very well, and notwithstanding its admirable flavor and texture it is not striking enough in appearance to meet the demands of our markets. In France the Chasselas is not generally much valued as a wine-grape; though the Gutedel wines of Germany and Switzerland are light, pleasant, and much esteemed. On the whole, this variety has given more satisfaction in California as a wine-grape than as a table-grape.

As a wine-grape its value depends altogether on the conditions under which it is grown. In the coast counties it is healthy, fairly vigorous, and productive; in the interior valleys it is a failure. On warm, well-drained southern or western slopes in the central coast counties it produces an excellent wine, clean-tasting, full-bodied, without much distinctive flavor or aroma, but developing a good bouquet with age, and keeping well. In these situations it has the advantage, especially desirable for white wines, of attaining perfect maturity, and even passing it without becoming too high in sugar or falling so low in acid as to make it difficult to ferment. Grapes from low or cold soils often ferment badly and easily go wrong. The average must composition has been: at Cupertino, 21.9% of sugar and 0.35% of acid; at Mission San José, 22.2% of sugar and 0.37% of acid; at Tulare, 22.3% of sugar and 0.23% of acid. At Cupertino the average crop has been four tons per acre; at Tulare, less than two tons. In none of these localities are the results as good as those obtained with this grape on warm slopes of Napa, Sonoma, and Santa Clara, where the conditions insure a more favorable must composition than is indicated by the above averages.

The Chasselas is almost always pruned short, though occasionally in rich soils it has been found advantageous to prune it long, but only when the grapes are to be used for eating. It is of great importance to choose fertile canes in the propagation of this variety, in order to insure good-bearing vines. The vines are somewhat subject to attacks of fungous diseases, and succumb quickly to the phylloxera. There is a variety of the Chasselas doré known as the Parsley vine, in French "Cioutat," having deeply cut or lacinate leaves, but which, with the exception of the leaves, is identical with the type.

TABLE OF PRODUCTION.

CHASSELAS DORÉ.	Number of Vines	Total Weight of Grapes, in lbs.	Average per Vine, in lbs.	Date of Picking
1887—No. 696 (long-pruned). J. T. Doyle, Cupertino	20	210	10.5	Oct. 5
1888—No. 917 (short-pruned). J. T. Doyle, Cupertino	20	130	6.5	Oct. 18
No. 918 (long-pruned). J. T. Doyle, Cupertino	20	320	16.0	Oct. 18
1889—Row 25 (short-pruned). J. T. Doyle, Cupertino	20	250	12.5	Oct. 9

ANALYSES OF MUSTS AND WINES.

CHASSELAS DORÉ.	Date of Picking	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Body
1886—No. 476. J. T. Doyle, Cupertino	Sept. 15	17.50	------	.40	.25	6.89	8.61	.41	------
1887—No. 696. J. T. Doyle, Cupertino	Oct. 5	23.17	23.61	.31	.33	9.34	11.64	.53	1.87
1888—No. 917 (short-pruned). J. T. Doyle, Cupertino	Oct. 18	22.89	24.12	.20	.50	9.20	11.45	.38	2.25
No. 918 (long-pruned). J. T. Doyle, Cupertino	Oct. 18	22.24	22.67	.22	.33				
1889—No. 1112. J. Gallegos, Mission San José	Sept. 28	22.60	21.80	.25	.38	9.20	11.45	.28	2.28
1890—No. 1260. J. Gallegos, Mission San José	Sept. 23	21.93	------	.40	.26	------	------	------	------
No. 1267. J. T. Doyle, Cupertino	Sept. 29	22.30	------	.44	.29	------	------	------	------
1891—No. 1448. Tulare	Aug. 26	24.53	------	.18	------	------	------	------	------
No. 1561. Mission San José	Oct. 6	22.15	------	.40	------	9.20	11.45	.39	1.80
1892—No. 1677. Tulare	Sept. 18	20.20	------	.29	------	7.92	9.90	.40	2.70
No. 1776. Mission San José	Oct. 13	20.85	21.38	.37	------	8.84	11.00	.53	2.10
1893—No. 1948. Mission San José	Oct. 14	23.70	------	.46	------	------	------	------	------
No. 2086. J. T. Doyle, Cupertino	Nov. 6	23.10	------	.53	------	------	------	------	------
1894—No. 2247. Mission San José	Oct. 3	21.90	------	.35	------	------	------	------	------
No. 2324. Tulare	Oct. 13	22.15	------	.21	------	------	------	------	------

RECORD OF TREATMENT.

No. 696. *Chasselas doré,* from J. T. Doyle, Cupertino. Received October 6, 1887, in good condition, but overripe. The bunches showed a little coulure, and varied from loose to compact; the berries were uneven in size. The must showed 23.17% of solid contents by spindle and 0.31% of acid. The temperature of the grapes at crushing was 69°, and the maximum reached was 85°, on the second day. The fermenting must was thoroughly aërated for twenty minutes on the first, second, third, and fourth days. The wine was quite dry on the eighth day.

At two weeks the wine was racked and taken to the cellar. At two months it was a thin wine, and the acid was evidently increasing, so it was racked again and pasteurized. Five days after pasteurizing it was still a little cloudy, had pleasant flavor and aroma, but was thin and too acid. At eight months it was nearly bright, and was a pleasant wine, with some bouquet, but showed the effect of secondary fermentation.

Nos. 917 and 918. *Chasselas doré,* from J. T. Doyle, Cupertino. Received October 19, 1888, in good condition. No. 917, which was from short-pruned vines, showed less coulure than No. 918, from long-pruned vines. The composition of the must of No. 917 was 22.89% of solid contents by spindle and 0.20% of acid; that of No. 918, 22.24% of solid contents by spindle and 0.22% of acid. The grapes of both lots, which were quite mature, were crushed together. The temperature of the must at the maximum was 85°. The wine fermented slowly, and was dry in fifteen days.

At three weeks the wine was racked and placed in the cellar. At seven weeks it was racked again. At three months it tasted thin and characterless. Two months later it was necessary to pasteurize it, as it showed signs of going wrong. Three months later it was racked, and at ten months it showed some good qualities, but was not quite bright. At fourteen months some wine bottled at eight months tasted quite as good as the wine in the keg. At sixteen months the wine, both in the keg and in the demijohn, was clean-tasting, but not of high quality; it was racked again. At seventeen months more of the wine was bottled. At eighteen months it was given a half-hour treatment in an electric machine. At twenty-one months it was bright, and of fair quality; the flavor was rather agreeable, but the bouquet and after-taste were not pleasing. A month later the rest of the wine was bottled. At two years and four months the wine bottled at eight months was bright, of neutral flavor, without bouquet, and with suspicion of bad acid. That bottled at seventeen months was bright and of more agreeable flavor than the above; there was a slight deposit in the bottles. That bottled at twenty-two months was similar to the second bottling, but had made no deposit. Nineteen months later the first and second bottlings were not nearly so good as the last, which had been treated by electricity.

No. 1112. *Chasselas doré,* from J. Gallegos, Mission San José. Received October 1, 1889, in good condition. The bunches were large and close; the berries large. The must showed 22.6% of solid contents by spindle and 0.25% of acid. The must was fermented in a closed keg surrounded by a jacket of water kept at a temperature of 65.5°. The wine was drawn off the thick lees on the eighteenth day.

At two months, when it was racked and taken to the cellar, it was clear and good, but somewhat thin. Two months later it was bright and smooth, somewhat characterless, and undeveloped. At five months the lees showed unsound ferments, and the wine was pasteurized. Six weeks later it was clear and sound. At nine months it was bright, smooth and agreeable, but with little character. A month later an examination of the lees showed no unsound germs; the wine was racked, and was clear and improved, but lacking in acid. At fifteen months it was bright and sound, but tasted thin. Six weeks later it was bottled. A year after bottling it was in good condition and had made a little deposit; it was smooth and fairly pleasing, but somewhat exhausted.

No. 1260. *Chasselas doré,* from Mission San José. A sample for must analysis was received September 26, 1890, in good condition. Bunches and grapes were large, the latter mature. The must showed 21.93% of solid contents by spindle.

No. 1267. *Chasselas doré,* from J. T. Doyle, Cupertino. A sample for must analysis arrived October 2, 1893, in good condition, and mature. The berries were, in general, large, but mixed with many small ones. The must showed 22.3% of solid contents by spindle.

No. 1448. *Chasselas doré,* from Tulare station. A sample for must analysis arrived August 29, 1891, in good condition. The must showed 24.53% of solid contents by spindle.

No. 1561. *Chasselas doré,* from Mission San José. Received October 9, 1893, in good condition; mature and not shriveled, but turning pink. The must showed 22.15% of solid contents by spindle. The must reached its highest temperature on the fourth day at 82°, and was dry on the seventh day.

At six weeks from crushing the wine was nearly clear, and of good flavor. At five months it had been racked twice, was bright, with some bouquet, and good though not marked flavor, very soft and pleasing, maturing slowly. During the first year it was racked four times, and at seventeen months it was bottled, when it showed little improvement and lack of body.

No. 1677. *Chasselas doré,* from Tulare station. Received September 21, 1892, in good condition, but rather soft. The must showed 20.2% of solid contents by spindle. The fermentation was cool, and lasted six days.

At five weeks the wine was quite dry and clear, and was racked for the second time. At four months it was bright, with a light but pleasing bouquet and flavor—a very smooth, neutral wine. It continued to improve for seven or eight months, after which it deteriorated, and though it remained bright and sound, it became mawkish and insipid.

No. 1776. *Chasselas doré*, from Mission San José. Received October 15, 1892, in good condition. The must showed 20.85% of solid contents by spindle. The must was fermented with 23% of Johannisberger, and went through in six days, attaining a maximum temperature of 82° on the fourth day.

The wine was clear in three weeks, and was racked twice during the first month. At three months it was an excellent wine, with rich flavor, aroma, and good body. At eight months it was in first-class order, of good quality, and almost mature. At eighteen months the wine was mature, and was bottled.

No. 1948. *Chasselas doré*, from Mission San José. A sample for must analysis was received October 14, 1893, in poor condition—very moldy, but fine grapes and fully ripe. The must showed 23.7% of solid contents by spindle.

No. 2086. *Chasselas doré*, from J. T. Doyle, Cupertino. A sample for must analysis was received November 6, 1893, in good condition. Bunches were of medium size, well filled; berries overripe and soft, but with no raisin taste. The must showed 23.1% of solid contents by spindle.

UGNI BLANC.

(See Vit. Rept. 1883–85, p. 137.)

Synonyms: Maccabeo; Queue de Renard; Clairette à grains ronds.

Description.—Vine vigorous, with long, reddish-gray canes of average thickness and long internodes; leaves of medium size, with upper sinuses deep and often closed, lower sinuses shallower and open, teeth large and acute, upper surface yellowish, downy when young, lower surface whitish, with a thick down; bunch long, cylindrical, with or without small shoulders, well filled; berries of medium size, round, white, becoming russet on one side when well ripened, soft, juicy, with tough but easily broken skin.

The Ugni blanc is very late, and only ripens well in the hottest regions of Provence. It is not exacting as to the nature of the soil in which it grows, providing it is not too wet. It buds out late in spring, thus escaping the late frosts. It gives, especially when grown on rocky hills, a generous wine, which, with age, acquires something of the character of Marsala. It is to this grape that the white wines of Cassis, in Bouches du Rhone, owe their quality.

So far, it has not shown qualities in California that would recommend it for cultivation in any locality. Its average yield has been two tons per acre at Cupertino and three tons at Tulare. Contrary to the reputation it has in France, it is here very easily injured by the weather and is not a particularly robust grower. It produces a light, acid wine, which is of fair quality, matures quickly, and is useful for blending. It is, however, little, if at all, better for this purpose than several others which are of superior productiveness. The average composition of the must at Mission San José and at Cupertino has been 20.9% of sugar and 0.76% of acid; at Tulare, 22.8% of sugar and 0.40% of acid.

TABLE OF PRODUCTION.

UGNI BLANC.	Number of Vines	Total Weight of Grapes, in lbs.	Average per Vine, in lbs.	Date of Picking
1887—No. 785 (long-pruned). J. T. Doyle, Cupertino	20	116	5.8	Oct. 27
1888—No. 954 (long-pruned). J. T. Doyle, Cupertino	18	110	6.1	Nov. 6
1889—No. 1195 (short-pruned). J. T. Doyle, Cupertino	19	140	7.3	Oct. 23

ANALYSES OF MUSTS AND WINES.

UGNI BLANC.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at 6 to 8 Months	Volatile Acid	Body	Ash
						By Weight	By Volume				
1884—No. 274. Natoma Wine Company, Natoma	-------	20.70	20.61	.59	.49	8.91	11.10	.51	------	2.00	.30
1887—No. 785. J. T. Doyle, Cupertino	Oct. 27	21.46	20.99	.87	.47	7.71	9.63	.56	.15	2.60	------
1888—No. 954. J. T. Doyle, Cupertino	Nov. 6	19.75	20.03	.50	.37	7.78	9.73	.45	------	2.30	------
1889—No. 1195. J. T. Doyle, Cupertino	Oct. 23	22.80	21.80	.51	.29	9.20	11.45	.39	------	2.00	------
1890—No. 1405. J. T. Doyle, Cupertino	Oct. 20	23.05	------	.91	.34	9.05	11.27	.74	------	1.54	------
1892—No. 1704. Tulare	Sept. 27	22.15	------	.45	------	------	------	------	------	------	------
No. 1737. Paso Robles	Oct. 10	24.20	------	.51	------	------	------	------	------	------	------
1893—No. 2026. J. T. Doyle, Cupertino	Oct. 31	22.40	------	1.00	------	------	------	------	------	------	------
1894—No. 2352. Tulare	Oct. 27	23.30	------	.36	------	------	------	------	------	------	------

RECORD OF TREATMENT.

No. 785. *Ugni blanc*, from J. T. Doyle, Cupertino. Received October 28, 1887, in good condition. The bunches were loosely pendent, and showed little coulure; the berries were very thin-skinned and juicy, perfectly round, and with little bloom; a few were shriveled and dried. The must showed 21.46% of solid contents by spindle, and 0.87% of acid. The temperature of the grapes at crushing was 74°, and the maximum reached was 84°, on the second day. The wine was dry on the fourth day.

At two weeks the wine was drawn off for the first time. At two months it showed little aroma and sharp acid. At four months the lees showed some acetic ferment, and the wine was drawn off and pasteurized. At seven months it was still cloudy, tasted green, and was highly acid; it had developed some bouquet, but was, on the whole, rather thin and poor. At eight months it was bright, but later it deteriorated.

No. 954. *Ugni blanc*, from J. T. Doyle, Cupertino. Received November 7, 1888, in good condition, and crushed the following day. The must showed 19.75% of solid contents by spindle and 0.50% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 81°, on the fourth day.

At two weeks the wine was drawn off the thick lees, and at one month it was taken to the cellar. At two months it was a thin, acid wine, with little aroma and low alcohol At four months it was racked again, and the lees found to be healthy. At ten months it was clear, and had improved. At thirteen months the wine which had been put in bottle at four months was better than the wine in the keg, both in flavor and cleanness of taste. At fifteen months it was clear, mature, neutral, but fairly agreeable. A month later it was racked. At this time it was at its best, and later it deteriorated.

No. 1195. *Ugni blanc*, from J. T. Doyle, Cupertino. Received October 24, 1889, in bad condition—injured by rain, but quite mature. The bunches were very unequal in size, the larger ones very large, long, cylindrical, shouldered, and compact; the berries were round and of medium size, with thin but tough skin, varying from green to pinkish; flesh very soft and juicy; stems of medium size, pedicels long and slender. The must showed 22.8% of solid contents by spindle and 0.51% of acid. The temperature of the grapes at crushing was 68°, and the maximum reached was 76.5°, on the third day. The wine continued fermenting slowly for a long time.

At two weeks the wine was drawn off the thick lees. At six weeks it was clear, very light in color, smooth, with faint aroma and agreeable flavor, with sufficient body and alcohol, and, in general, rather pleasing. At two months it was racked and taken to the cellar, and at three months it was bright and had improved. At six months it was racked again, and at seven months the lees were examined and found to be healthy. At eight months the wine was bright, had developed some bouquet, and was, in general, a smooth, light, and pleasing wine, nearly mature. After this it deteriorated.

No. 1405. *Ugni blanc*, from J. T. Doyle, Cupertino. Received October 23, 1890, in fair condition, and mature. The must showed 23.05% of solid contents by spindle. The fermentation reached its maximum on the third day at a temperature of 82°, and lasted eight days.

A month from crushing the wine was nearly clear, had full flavor and acid, light body, and clean taste. At two months from crushing it was racked, and at three months was bright, and showed some improvement and the development of some bouquet. At five months the lees showed a few filaments, but the taste was unaffected; it was pasteurized for safety. It remained bright, and at fourteen months was mature, had a good flavor, a little bouquet, high but somewhat green acid, and in general was of fair quality. At fifteen months it was bottled. At two years it showed good qualities, but was somewhat exhausted.

No. 1704. *Ugni blanc*, from Tulare station. A sample for must analysis was received September 29, 1892, in good condition, but very small, having been grown on alkali soil. The must showed 22.15% of solid contents by spindle.

No. 1737. *Ugni blanc*, from Paso Robles station. A sample for must analysis arrived October 13, 1892, in good condition. The must showed 24.2% of solid contents by spindle.

No. 2026. *Ugni blanc*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 31, 1893, in good condition. The bunches were over medium in size, long-cylindrical, scarcely shouldered, and close; the berries of medium size, very juicy, and thick-skinned, with high acid, and not quite mature. The must showed 22.4% of solid contents by spindle.

VERDAL.

(See Vit. Rept., 1885-86, p. 104.)

Synonyms: Aspiran blanc; Servan blanc (?).

This grape has found quite extended acceptance for table use, and to some extent for wine. It is a grape of southern France, particularly the Languedoc, and in its three varieties—the red, gray, and white—is quite extensively grown, for both table use and wine-making. The white variety, which is less prolific than the other two, is used for the table only, while the other two produce very popular table wines, of which the red, however, lacks sufficient color for commercial use, and neither it nor the white is exported. The wines possess a light aroma or perfume peculiar to this grape. The vine is pruned sometimes with one long spur, but mostly altogether short.

Description.—Vine of medium vigor and rather hardy; canes somewhat slender and half erect; leaves of average size, glabrous on both surfaces, except below near the axils of the main nerves, sinuses well marked and generally closed, giving the leaf the appearance of having five holes, in the manner of those of Cabernet Sauvignon; teeth long, unequal, and somewhat acuminate; bunches large to very large, irregularly long-conical, without any or with small shoulders, well-filled to compact; berries large to very large, crisp, with thick but tender skin, agreeable, but without marked flavor.

This variety has proved to be a good grower and prolific bearer almost wherever grown, is little subject to disease, and shades its grapes well. In the cooler localities it is occasionally injured by coulure and by the abortion of its berries. The vines are sometimes pruned long, but in places suited to the variety it will bear enough, or even too much, with short-pruning; long canes tend to exhaust the vine. The grapes have been successful for table use, on account of their lateness and their good keeping qualities; they will hang and remain sound on the vines later than almost any other variety. As a wine-grape, it is less recommendable, making in the Coast Range a thin wine of little character.

In the hot interior valleys it is at its best as a wine-grape. At Tulare, where it produces nearly fourteen tons per acre, it makes a light, agreeable wine, with little flavor or bouquet, but easily fermented and handled; a wine which, at six or eight months, is at its best, bright, and clean-tasting. It is too light to keep for a long time, but would make a good blend with heavy-bodied, alcoholic wines. For this purpose it is, however, not equal to the Burger, but has the advantage of being at the same time a good table-grape, and of resisting the weather better than the latter.

The average composition of the must at Tulare has been 18.4% of sugar and 0.57% of acid. This could probably be improved by preventing the vines from bearing so heavily. At Paso Robles the grape is promising, being vigorous and productive, and having an average must composition of 21.6% of sugar and 0.51% of acid, but has not yet been sufficiently tried for wine.

ANALYSES OF MUSTS AND WINES.

VERDAL.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Volatile Acid	Body	Ash
1885—No. 367.	D. C. Feely, Patchen	----	14.91	----	.53	.26	6.42	8.07	.52	----	1.80	.19
1886—No. 512.	R. Wegener, Livermore	----	21.80	21.07	.38	.30	8.27	10.36	.41	----	1.80	----
No. 585.	D. C. Feely, Patchen	----	17.00	15.11	.63	.47	6.75	8.46	.55	----	1.55	----
1887—No. 701.	R. Wegener, Livermore	Oct. 5	22.84	23.22	.52	.37	8.62	10.75	.43	.08	2.60	----
No. 803.	W. G. Klee, Glenwood	Nov. 29	20.65	20.10	.75	.40	----	----	----	----	----	----
1889—No. 1164.	J. T. Doyle, Cupertino	Oct. 12	21.50		.48	----	----	----	----	----	----	----
No. 1188.	J. Gallegos, Mission San José	Oct. 13	19.50	----	.57	----	----	----	----	----	----	----
1890—No. 1361.	J. T. Doyle, Cupertino	Oct. 14	18.95	----	.84	.22	7.78	9.73	.46	----	1.80	----
No. 1430.	J. Gallegos, Mission San José	Oct. 27	22.15	----	.63	----	----	----	----	----	----	----
1891—No. 1453.	Tulare	Aug. 27	18.82	18.30	.53	----	6.42	8.07	.40	----	2.60	----
1892—No. 1705.	Tulare	Oct. 4	20.40	19.75	.42	.43	8.84	11.00	.46	----	2.30	----
1893—No. 1912.	Tulare	Oct. 5	18.80	17.70	.75	.39	7.43	9.27	.48	----	2.60	----
No. 1964.	Paso Robles	Oct. 12	22.85	----	.52	----	----	----	----	----	----	----
No. 1982.	Tulare	Oct. 17	19.30	18.46	.58	.25	7.64	9.54	.45	----	2.60	----
No. 2082.	Paso Robles	Nov. 3	22.70	21.63	.51	.37	8.34	10.12	.51	----	2.25	----
1894—No. 2233.	Mission San José	Oct. 3	20.40	----	.53	----	----	----	----	----	----	----
No. 2342.	Tulare	Oct. 20	19.30	17.99	.59	----	----	----	----	----	----	----

Record of Treatment.

No. 701. *Verdal*, from R. Wegener, Livermore. Received October 7, 1887, in good condition. The bunches were large, loose, and showed a little coulure; the berries were large, and well covered with bloom. The must showed 22.84% of solid contents by spindle and 0.52% of acid. The temperature of the grapes at crushing was 65.5°, and the maximum reached was 89°, on the third day. The wine was drawn off on the eleventh day.

At two months it was clear, with good aroma, light and pleasant acid, but was rather thin. A month later it was racked again. At sixth months the lees showed traces of unsound ferments, so the wine was racked and pasteurized. At eight months it was bright, with little bouquet—a fair, neutral wine.

No. 803. *Verdal*, from W. G. Klee, Santa Cruz Mountains. A sample for must analysis was received November 30, 1887, in fair condition, some of the bunches showing traces of mold. The bunches were very large and loose, on account of coulure. The berries were very large, and with much less bloom than the sample from Livermore; however, they were larger than those of the latter sample, and of more agreeable flavor. The must showed 20.65% of solid contents by spindle and 0.75% of acid.

No. 1164. *Verdal*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 15, 1889, in good condition. The bunches were large to medium, pyramidal, winged, loose; the berries very large, ellipsoidal, with thick but tender skin, of green to yellowish-green color, well covered with bloom; the flesh crisp and juicy, sweet, and agreeable; the stems slender and green; the pedicels short and thick. The must showed 21.5% of solid contents by spindle and 0.48% of acid.

No. 1188. *Verdal*, from J. Gallegos, Mission San José. A sample for must analysis was received October 16, 1889, in good condition. The grapes were rather larger than those from Cupertino, but were otherwise identical. The must showed 19.5% of solid contents by spindle and 0.57% of acid.

No. 1361. *Verdal*, from J. T. Doyle, Cupertino. Received October 17, 1890, in good condition, but not mature. The must showed 18.95% of solid contents by spindle. The fermentation was slow and cool, attaining its maximum temperature of 78° on the fourth day, and finishing on the sixth day.

The wine was racked twice during the first two months, but was slow in clearing. At three months it was bright, with a slight bouquet, but very little flavor, high acid, and somewhat suspicious after-taste—generally of poor quality and without character. At five months the lees showed a little lactic ferment, and the wine was pasteurized. At seven months the wine was bright, had improved somewhat in taste and bouquet, but tasted green, and was without much character. At fourteen months the wine was mature, and at sixteen months it was bottled. At two years the wine was examined and found to be bright; it was thin and neutral, but smooth and somewhat agreeable.

No. 1430. *Verdal*, from J. Gallegos, Mission San José. A sample for must analysis was received October 30, 1890, in good condition, and mature. The must showed 22.15% of solid contents by spindle.

No. 1453. *Verdal*, from Tulare station. Received August 29, 1891, in good condition, but not ripe. The must showed 18.82% of solid contents by spindle. The fermentation lasted five days, was cool and complete, and reached its maximum temperature of 76° on the third day.

The wine remained cloudy for some time, but was bright at seven weeks after crushing. During the first three months it was racked twice, and at four months it was bright, water-white, with a little bouquet—generally neutral, but drinkable, and well advanced for its age. Tastings at six and eight months showed it to have improved somewhat and to have kept perfectly. At fourteen months the wine was mature, thin, and without character; at this age it was bottled.

No. 1705. *Verdal*, from Tulare station. Received October 5, 1892, in excellent condition. The grapes were of very large size, and mature. The must showed 20.4% of solid contents by spindle. The fermentation was somewhat slow, lasting eight days, and reaching its maximum temperature of 83° on the third day.

At one month the wine was clear, fresh-tasting, and quite dry; it was racked twice during the first three months, and at the end of that time was bright, with some bouquet and flavor, a nutty taste, and signs of early maturity. It remained bright, sound, and generally in good order for sixteen months, when it was bottled.

No. 1912. *Verdal*, from Tulare station. Received October 6, 1893, in fairly good condition—a trifle bruised, but not at all moldy. The must showed 18.80% of solid contents by spindle. The amount received (752 lbs.) was divided into three lots, one of which was fermented in the ordinary way, and the others with special ferments. The normal fermentation, which was made for comparison, was prompt and thorough, lasting four days, and attaining a maximum temperature of 81° on the second day.

The wine was clean-tasting, and nearly clear three weeks after crushing. Four months after the first drawing-off it was bright, with full acid, but with little flavor and no bouquet. Three months later it had made little change.

No. 1964. *Verdal*, from Paso Robles station. A sample for must analysis arrived October 14, 1893, in fair condition. The bunches were large, irregular, and compact; the berries large (smaller than those from Tulare), and not quite ripe. The must showed 22.85% of solid contents by spindle.

No. 1982. *Verdal* (*Napoleon*), from Tulare station. Received October 19, 1893, in good condition. Bunches and berries both extremely large; berries not very sweet, but riper than those received under the name of Verdal from the same station (No. 1912). The must showed 19.3% of solid contents by spindle. The must fermented quickly, reached a temperature of 82° on the third day, and was dry on the fourth.

The wine cleared quickly, and three months from crushing, when it had been racked twice, it was bright and clean-tasting. Six months after making, it was in good condition, fresh-tasting, and agreeable, but with little character.

No. 2082. *Verdal*, from Paso Robles station. Received November 4, 1893, in good condition. The bunches were very irregular in size and shape, large, and either loose or compact; the berries were large to very large, sweet, with very little flavor. The must showed 22.7% of solid contents by spindle. The fermentation was rather slow and cool, the temperature not rising above 77°.

The wine was clear at five weeks, having been racked twice. At ten weeks it was bright, clean-tasting, with some bouquet and flavor, and medium acid. At six months it was smooth and agreeable, with some bouquet, but no marked character.

CHAUCHÉ GRIS.

(See Vit. Rept. 1885–86, p. 101.)

Synonyms: Gray Riesling; Gray D'Ischia (in California).

Description.—A strong, vigorous grower, with abundant foliage; canes thick, with short internodes; leaves of medium size, circular outline, with shallow sinuses or without any, glabrous above, soft-downy below; bunches small, conical, shouldered, compact; berries small, ellipsoidal, from greenish-pink to reddish, with abundant bloom.

This variety has been planted pretty extensively, is vigorous in almost all localities, and generally fairly resistant to disease, except where *oidium* is prevalent, in which places it needs several sulphurings. The vines require long-pruning, but when trained in the usual way the crop is often a total failure, on account of coulure. This tendency to coulure can be overcome by the Guyot system of pruning; the canes tied to the horizontal wires must be very long, and renewed every year. The grapes ripen early, and generally color well; they are very hard and difficult to press. In general, the must is very high in sugar and rather low in acid; it is difficult to ferment, and very slow to clear, especially if it has been allowed to remain for any length of time in contact with the skins.

The localities where this grape has given the most satisfaction are in the higher parts of the Santa Cruz Mountains. Here the sugar content is lower and the acid higher than in the other localities, where it averages 25% of sugar and 0.45% of acid. In favorable localities it gives a wine of good bouquet, clean taste and full body, and produces, when properly pruned, at the rate of 5 to 6 tons per acre. The average crop at Cupertino on the long-pruned vines has been 5.7 tons per acre, while on the short-pruned it has been only 0.4 ton. It has borne well at the Amador station, but in composition the must has been too high in sugar and too low in acid to promise well for a dry wine.

TABLE OF PRODUCTION.

CHAUCHÉ GRIS.	Number of Vines	Total Weight of Grapes, in lbs.	Average per Vine, in lbs.	Date of Picking
1887—No. 694 (long-pruned). J. T. Doyle, Cupertino	20	172	8.6	Oct. 4
No. 707 (short-pruned). J. T. Doyle, Cupertino	20	15	0.7	Oct. 10
1888—No. 882 (long-pruned). J. T. Doyle, Cupertino	20	386	19.3	Oct. 3
No. 883 (short-pruned). J. T. Doyle, Cupertino	20	30	1.5	Oct. 3
1889—No. 1101. J. T. Doyle, Cupertino	20	450	22.5	Sept. 26

Analyses of Musts and Wines.

CHAUCHÉ GRIS.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Volatile Acid	Body	Ash
1883—No. 92. Charles King, St. Helena		20.94	21.38	.51	.33	10.07	12.54	.68		1.42	.23
No. 92*a*.† Charles King, St. Helena		20.94	21.38	.51	.33	8.91	11.10	‡.63		1.93	.38
No. 93. W. G. Klee, Glenwood		18.96	19.89	.52	.29	9.27	11.54	.60		1.53	.17
No. 93*a*.† W. G. Klee, Glenwood		18.96	19.89	.52	.29	9.05	11.27	§.63		1.73	.25
1884—No 117.* R. Barton, Fresno						9.20	11.45	.66		2.05	.26
1885—No. 359. W. G. Klee, Glenwood		22.80		.41	.28	10.54	13.00	.35		1.80	.25
1886—No. 489. J. T. Doyle, Cupertino		20.90	20.65	.50	.36	8.13	10.17	.55		1.80	
No. 540. J. S. Fowler, Patchen		22.00	21.38	.43	.41	8.77	10.91	.38		1.90	
1887—No. 682. Margherita Vineyard, Fresno	Aug. 29	24.80	24.12	.57	.40	10.81	13.27	.50	.08	2.80	
No. 694 (long-pruned). J. T. Doyle, Cupertino	Oct. 4	25.13	26.31	.50	.39	10.91	13.36	.43		2.50	
No. 707 (short-pruned). J. T. Doyle, Cupertino	Oct. 10	28.78	28.33	.45	.40						
1888—No 839. J. Gallegos, Mission San José	Sept. 10	25.52		.42							
No. 882 (long-pruned). J. T. Doyle, Cupertino	Oct. 3	23.32	23.62	.32	.41	9.70	12.09	.53		2.00	
No. 883 (short-pruned). J. T. Doyle, Cupertino	Oct. 3	24.92	26.00	.29	.49						
1889—No. 1030. Margherita Vineyard, Fresno	Aug. 29	31.10	30.63	.60	.91						
No. 1084. J. Gallegos, Mission San José	Sept. 16	25.90	25.76	.48	.50	10.72	13.18	.37		2.45	
No. 1096. Margherita Vineyard, Fresno	Sept. 16	28.00	27.75	.37	.59	13.15	16.20	.30		3.35	
No. 1101. J. T. Doyle, Cupertino	Sept. 26	25.55		.39							
1890—No. 1207. Margherita Vineyard, Fresno	Aug. 11	22.82	22.67	.48	.50	8.90	11.18	.22		2.15	
No. 1286. J. T. Doyle, Cupertino	Oct. 1	25.44		.36							
1891—No. 1495. Paso Robles	Sept. 13	25.20		.38							
No. 1499. Asti, Sonoma County	Sept. 14	24.80	24.12	.41	.28	9.63	12.00	.44		3.15	
No. 1509. Mission San José	Sept. 24	25.40	25.76	.44		10.63	13.09	.30		2.45	
1892—No. 1649. Paso Robles	Sept. 13	25.20		.45							
No. 1774. Mission San José	Oct. 14	24.80	23.60	.44		9.56	11.91	.60		2.50	
1893—No. 1801. Amador station	Aug. 30	21.30		.72							
No. 1864. Paso Robles	Sept. 13	23.30	22.60	.50	.36	9.05	11.27	.49		2.30	
No. 1987. Mission San José	Oct. 19	25.95	25.19	.52		11.46	14.00	.58		2.60	
No. 2096. Cupertino	Nov. 6	25.20		.36							
1894—No. 2145. Amador station	Sept. 11	25.50		.45							
No. 2240. Mission San José	Oct. 3	25.85		.48							

*Wine sent for examination. †Fermented with skins. ‡Acid at pressing, 0.43%. §Acid at pressing, 0.44%; tannin, 0.035%.

RECORD OF TREATMENT.

No. 682. *Chauché gris*, from Margherita Vineyard, Fresno. Received August 31, 1887, in fair condition. The bunches were large and looser than those from Cupertino; the berries also large and deeply colored. The must showed 24.8% of solid contents by spindle and 0.57% of acid. The temperature of the grapes at crushing was 63°, and the maximum reached was 78°, on the fifth day. The fermentation was slow, and lasted about seventeen days.

At three weeks the wine was drawn off the thick lees. Three months later it was still turbid, and showed indications of secondary fermentation. A microscopic examination of the lees confirmed the indications of the taste, so the wine was racked and pasteurized. A month later it was bright, and had developed some bouquet; it had medium body and adequate acid. The wine as a whole was pleasant and of good quality, except for a rather unpleasant after-taste.

No. 694. *Chauché gris*, from J. T. Doyle, Cupertino. Received October 6, 1887, in good condition. The bunches were well filled, and the berries of good size for the variety, and deeply colored. The must showed 25.13% of solid contents by spindle and 0.50% of acid. The temperature of the grapes at crushing was 71°, and the maximum reached was 88°, on the third day.

At two weeks the wine was drawn off the heavy lees. At two months it was bright, with light acid and aroma, and a fairly well-developed wine. A month later it was racked again; it had developed a little bouquet, but the acid tasted a little sharpish. A microscopic examination of the lees showed some unsound ferments, so the wine was racked again two weeks later, and pasteurized.

No. 707. *Chauché gris*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 11, 1887, in good condition. The grapes were from short-pruned vines, and did not differ materially from those from long-pruned vines. They showed rather more coulure and there were more dried grapes, on account of the hot days immediately preceding their gathering. The must showed 28.78% of solid contents by spindle and 0.45% of acid.

No. 839. *Chauché gris*, from J. Gallegos, Mission San José. A sample for must analysis was received September 12, 1888, in good condition. The must showed 25.52% of solid contents by spindle and 0.42% of acid.

Nos. 882 (long-pruned) and 883 (short-pruned). *Chauché gris*, from J. T. Doyle, Cupertino. Received October 5, 1888, in good condition. The must of the grapes from long-pruned vines showed 23.32% of solid contents by spindle and 0.32% of acid. The grapes from short-pruned vines showed a great deal of coulure, and the must showed 24.92% of solid contents by spindle and 0.29% of acid. The two lots were fermented together. The maximum temperature, reached the fourth day, was 89°. The wine was quite dry on the tenth day, when it was drawn off the thick lees.

At three months the wine was not quite clear, but showed good aroma. Two months later it was pasteurized, on account of the presence of small quantities of unsound ferments in the lees. At eleven months it was clear and of fair quality, but with a slightly suspicious odor. At seventeen months it had deteriorated and become slightly bitter. It was racked again at this time, but did not improve.

No. 1030. *Chauché gris*, from Margherita Vineyard, Fresno. A sample for must analysis was received September 2, 1889, in good condition. The must showed 31.1% of solid contents by spindle and 0.60% of acid.

No. 1084. *Chauché gris*, from J. Gallegos, Mission San José. Received September 19, 1889, in good condition, and completely mature. The must showed 25.9% of solid contents by spindle and 0.48% of acid. The maximum temperature reached by the fermenting must was 83°, on the third day. The wine was dry on the sixth day.

At one month the wine was almost clear, clean-tasting, and with pleasing aroma. Eight days later it was clear, and in two weeks was taken to the cellar. At four months it was clear, of light golden color, with marked and agreeable aroma, rather raw still, but of good general quality. At seven months it was racked for the third time. It became cloudy, and showed signs of secondary fermentation, so it was submitted to electrical treatment for an hour. Two months later the wine tasted exhausted, and had evidently not been benefited by the treatment, as it steadily deteriorated after this.

No. 1096. *Chauché gris*, from Margherita Vineyard, Fresno. Received September 20, 1889, in good condition, but overripe. The bunches were larger and looser than usual; the berries softer and more juicy than those of the same variety from Mission San José. The skin was almost rose-colored. The must showed 28.0% of solid contents by spindle and 0.37% of acid. The fermentation reached its maximum on the third day at a temperature of 79.5°. The wine was nearly dry on the fifth day.

At one month the wine was racked and taken to the cellar. It was bright, of light golden-yellow color, of faint flavor and aroma, full body, medium acid, and good general quality. At four months it was bright, full-bodied, and rather rough for a white wine. Three months later it was pasteurized, as the lees showed signs of unsound ferments. There were traces of sugar in the wine, which started the secondary ferments again later, so that the wine did not improve. At one year the wine, which had been kept in demijohn since it was pasteurized, was fairly good, but the wine in the keg was bitter. After this it did not improve.

No. 1101. *Chauché gris*, from J. T. Doyle, Cupertino. A sample for must analysis was received September 27, 1889, in good condition, and quite ripe. The bunches were of medium size, cylindrical, sometimes shouldered, close; the berries of normal size, firm and not juicy, sweet and agreeable. The must showed 25.55% of solid contents by spindle and 0.39% of acid.

No. 1207. *Chauché gris*, from Margherita Vineyard, Fresno. Received August 14, 1890, in fairly good condition. Bunches compact and of fair size; berries firm, and completely mature. The must showed 22.82% of solid contents by spindle, and reached its maximum temperature of 79° on the fourth day; the fermentation was slow and prolonged.

Six weeks after crushing the wine was nearly clear, but still a little sweet and fermenting. At ten weeks the wine was quite clear, with pleasing but neutral flavor, good body and alcohol, medium acid, but no bouquet. It was racked four times the first year, but after six months commenced to deteriorate, becoming flat and insipid. At fourteen months it was bottled, but failed to keep in glass.

No. 1286. *Chauché gris*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 3, 1890, in fair condition; a few grapes moldy, quite ripe. The must showed 25.43% of solid contents by spindle.

No. 1495. *Chauché gris*, from Paso Robles station. A sample for must analysis arrived September 16, 1891, in good condition. The grapes were mature and very small. The must showed 25.2% of solid contents by spindle.

No. 1499. *Chauché gris*, from Asti, Sonoma County. Received September 17, 1891, in good condition, well-colored, and mature. The must showed 24.8% of solid contents by spindle. The fermentation was very feeble and slow, the must never rising more than 2° above the temperature of the room.

At the end of a month the wine was still sweet and fermentation had almost stopped; it was then treated with half a gallon of sediment from No. 1601, a White Vernaccia from Cupertino in full fermentation, and then aërated. Fermentation recommenced, and in four days the wine was almost dry. It never became quite clear, and at four months commenced to show signs of bad acid, and was therefore pasteurized. At six months it was racked, and at eight months it was quite bright, though still a little sweet. At ten months it was racked and lightly sulphured. At fourteen months it was bright, still slightly sweet, but quite sound and fairly agreeable. At fifteen months it was bottled.

No. 1509. *Chauché gris*, from Mission San José. Received September 27, 1891, in fair condition; a little moldy. The must showed 25.4% of solid contents by spindle. The must went through promptly in five days, reaching its maximum temperature of 81° on the third day.

The wine was a little slow in clearing, but was clear two months after crushing. It was racked twice during the first three months, and at the end of that time was bright, of fair quality, but slightly bitter. Eight months after crushing it was much improved, smooth, full-bodied, and pleasing. At fifteen months the wine had not developed much bouquet, but was mature, and was bottled.

No. 1649. *Chauché gris*, from Paso Robles station. A sample for must analysis was received September 16, 1892, in good condition. The must showed 25.2% of solid contents by spindle.

No. 1774. *Chauché gris*, from Mission San José. Received October 15, 1892, in good condition. The must showed 24.8% of solid contents by spindle. The fermentation reached its maximum temperature of 82° on the fourth day, and continued slowly for some time, and was slow in clearing.

The wine was racked twice during the first two months, and at three months was bright, had full flavor and a little bouquet, but was not quite clean-tasting. Tastings at five, eight, and ten months showed a gradual improvement and a quick maturing. At eighteen months the wine was bottled.

No. 1801. *Chauché gris*, from Amador station. A sample for must analysis was received September 1, 1893, in good condition. The bunches were small and well filled. The must showed 21.3% of solid contents by spindle.

No. 1864. *Chauché gris*, from Paso Robles station. Received September 15, 1893, in good condition. The bunches were very compact and large; the berries were large for the variety, unevenly ripened. The must showed 23.3% of solid contents by spindle. The must reached its maximum temperature of 82° on the fourth day, and fermented through in seven days.

The wine cleared in three weeks, and was racked twice during the first month. At four months it was bright, full-bodied, with a little flavor and bouquet, but still very raw. At eight months it was much improved, had acquired a good bouquet, a clean, sound after-taste, and was altogether an agreeable wine.

No. 1987. *Chauché gris*, from Mission San José. Received October 19, 1893, in good condition, very ripe, and more deeply colored than usual. The must showed 25.95% of solid contents by spindle. The must fermented slowly, and did not attain its maximum temperature of 81° until the fourth day; in eight days it was nearly dry.

At one month the wine was nearly clear, and was racked for the second time. At three months it was bright, but very raw. At seven months it was smoother, full-bodied, but quite clean-tasting.

No. 2096. *Chauché gris*, from J. T. Doyle, Cupertino. A sample for must analysis arrived November 6, 1893, in good condition. The bunches were small and compact; the berries small, deeply colored, overripe, but with good acid. The must showed 25.2% of solid contents by spindle.

BURGER.

(See Vit. Rept. 1883–85, p. 124; 1885–86, p. 93.)

Synonyms: White Tokay; Putszcheere; Elender.

The Burger, properly so called, is a grape of the northern part of the wine belt of Europe, and the grape passing under that name in California has been associated, both in the vineyards and cellars, with the (true) Riesling, the Gutedel or Chasselas, and other Rhenish grapes. Among these, it is in Europe held in but very light estimation as to quality, though known to produce large quantities of a light acid wine, poor in alcohol. Among its names is that of White Elbling; the Blue Elbling, largely cultivated by Mr. L. J. Rose at San Gabriel, being held to be one of its varieties.

However similar to the true Burger, or Kleinberger, in respect to the wine it yields, especially in northern localities, the California grape differs from the German type as well as from the Blue Elbling. From a comparison with a grape imported by Mr. Groezinger, Mr. Wetmore identifies our grape with the White Tokay, also known as Putszcheere, and Elender; both names indicative of no very high estimate of the variety, which seems to represent the Burger in Hungary.

This variety has been so extensively planted and is so well known in California that an extended description is unnecessary. It succeeds well in all localities which are not too late to ripen its grapes, bearing immense crops where the soil is rich, and good crops wherever vines will thrive at all.

Description.—Vine rather a small grower; leaves of medium size or smaller, the lateral sinuses well marked, often closed, the petiolar sinus narrow, dentation very obtuse, sometimes almost sinuate; the upper surface of leaves glabrous, the lower sparsely downy; bunch very large, irregular, generally very compact; berries a little over medium size, round, very juicy, and without special flavor.

The skin of the grapes is very easily broken, rendering them susceptible to damage by early rains. In the northern coast counties the variety produces a light acid wine of fair quality when planted in a warm and early location, but the best results have been obtained with it in the warmer southern and central counties. In Fresno and Tulare counties it attains very regularly from 20% to 23% of sugar, with from 0.6% to 0.4% of acid, ferments well, and produces one of the best white wines of those localities. In San Luis Obispo County it has also done well, retaining good acid with a fair amount of sugar. In the Sierra foothills it has not been so satisfactory; and in the northern coast counties it is too much at the mercy of early autumn rains and late seasons; for, though a clean, neutral wine of good keeping qualities is sometimes obtained from it, at other times, and more often, it gives a thin, watery, green-tasting wine, good only for distillation.

The crops reported as obtained from this variety vary from 2 tons (exceptionally small) in a red hill soil of Napa County, to 11 tons or more in rich soils. About 7 tons to the acre would seem to be about the average in ordinary soils. The average for three years at Cupertino has been 9.3 tons per acre.

Burger is preëminently a blending wine, especially useful as an addition to such wines as the Chauché gris, which it improves in acid and keeping qualities; it is also, on account of its neutral character, of use as a toning-down blend with wines of too strongly marked character, being often used as a diluent with red wines too rich in color, tannin, or special flavor. One of its especial merits is the ease with which it maintains and imparts to other musts a sound fermentation.

TABLE OF PRODUCTION.

BURGER.	Number of Vines	Total Weight of Grapes, in lbs.	Average per Vine, in lbs.	Date of Picking
1887—No. 748 (long-pruned). J. T. Doyle, Cupertino	20	535	26.7	Oct. 18
No. 754 (short-pruned). J. T. Doyle, Cupertino	20	445	22.2	Oct. 19
1888—No. 940 (short-pruned). J. T. Doyle, Cupertino	20	720	36.0	Oct. 25
No. 941 (long-pruned). J. T. Doyle, Cupertino	20	515	25.7	Oct. 25
1889—No. 1165. J. T. Doyle, Cupertino	20	500	25.0	Oct. 14

ANALYSES OF MUSTS AND WINES.

BURGER.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Volatile Acid	Body	Ash
1883—No. 112.* R. Barton, Fresno						9.12	11.36	.49		2.24	.37
1884—No. 113.* R. Barton, Fresno						8.98	11.17	.50		3.02	.26
No. 261. R. Barton, Fresno		20.06	19.96	.45	.45	8.55	10.63	.53		1.65	.18
No. 114.* L. J. Rose, San Gabriel						9.20	11.42	.40		2.16	.31
No. 261. Stern & Rose, San Gabriel		19.19	19.15	.51	.31	8.41	10.50	.60		2.05	.26
1885—No. 348. Leland Stanford, Vina		23.35		.39	.60	9.63	12.06	.68		2.69	.45
No. 349. C. Weller, Harrisburg		19.46		.80	.30	8.13	10.16	.65		1.93	.19
No. 362. H. Keatinge, Lower Lake		22.69		.47	.40	8.84	11.00	.54		1.68	.18
No. 366. D. C. Feeley, Patchen		12.62		.75	.32	4.76	6.00	.48		1.52	.23
1886—No. 471. Leland Stanford, Vina	Sept. 16	22.50		.50	.48	8.20	10.25	.75		1.80	
No. 501. J. T. Doyle, Cupertino	Sept. 27	13.10	11.68	1.02	.09	3.96	5.00	.79		1.30	
No. 508. R. Wegener, Livermore	Sept. 28	20.80	20.24	.44	.37	7.92	9.90	.40		2.05	
No. 572.† J. D. Cone, Sacramento		24.00	24.33	.39	.39						
1887—No. 748 (long-pruned). J. T. Doyle, Cupertino	Oct. 18	19.40	19.21	.65	.33	7.90	9.90	.54	.07	2.10	
No. 754 (short-pruned). J. T. Doyle, Cupertino	Oct. 19	21.98	21.63	.81	.37	9.20	11.45	.66	.03	2.30	
No. 692.* R. Wegener, Livermore	Sept. 28	22.87	22.67	.62	.42	8.98	11.18	.50	.02	2.30	
No. 681. Margherita Vineyard, Fresno	Aug. 28	23.24	22.67	.45	.53	9.92	12.36	.50	.11	2.60	
1888—No. 830. Margherita Vineyard, Fresno	Sept. 5	23.16	24.11	.34	.60	9.27	11.55	.58		2.10	
No. 940 (short-pruned). J. T. Doyle, Cupertino	Oct. 25	19.13	19.75	.31	.39	7.64	9.54	.55		1.40	
No. 941 (long-pruned). J. T. Doyle, Cupertino	Oct. 25	19.30	19.54	.63	.45						
1889—No. 1165. J. T. Doyle, Cupertino	Oct. 14	20.10		.63							
No. 1173. J. Gallegos, Mission San José	Oct. 15	21.20	21.55	.47	.32	8.34	10.42	.43		2.35	
1890—No. 1279. J. T. Doyle, Cupertino	Sept. 29	19.30		.87							
No. 1383. J. Gallegos, Mission San José	Oct. 17	20.20		.68	.34	9.20	11.45	.50		2.44	
1891—No. 1449. Tulare	Aug. 26	21.50		.53							
No. 1539. Paso Robles	Oct. 6	23.70		.45							
No. 1565. Mission San José	Oct. 6	20.60		.68		8.17	10.91	.62		2.30	
1892—No. 1644. Paso Robles	Sept. 14	19.05		.80							
No. 1660. Amador station	Sept. 16	21.10		.60							
No. 1667. Tulare	Sept. 16	19.60		.56	.36	7.78	9.73	.51		2.35	
No. 1773. Mission San José	Oct. 13	20.70	19.21	.79		8.84	11.00	.55		2.20	

1893—No. 1839.	Amador station	Sept. 6	15.20	------	.91	------	------	------	------	------	------	------
No. 1861.	Amador station	Sept. 13	17.70	------	.90	------	------	------	------	------	------	------
No. 1908.	Tulare	Oct. 3	20.00	19.21	.75	.44	7.75	9.70	.45	------	2.60	------
No. 2008.	Paso Robles	Oct. 25	22.05	21.40	.45	.39	8.84	11.00	.45	------	2.30	------
No. 2061.	Mission San José	Nov. 1	22.60	21.63	.79	.23	9.34	11.64	.71	------	2.15	------
No. 2085.	Cupertino	Nov. 6	17.20	------	.99	------	------	------	------	------	------	------
No. 2190.	Amador station	Sept. 25	24.35	------	.38	------	------	------	------	------	------	------
No. 2217.	Paso Robles	Sept. 28	22.80	------	.68	------	------	------	------	------	------	------
No. 2241.	Mission San José	Oct. 5	18.80	------	.69	------	------	------	------	------	------	------
No. 2315.	Amador station	Oct. 15	25.40	------	.41	------	------	------	------	------	------	------
No. 2333.	Tulare	Oct. 19	21.90	20.10	.55	------	8.13	10.17	.39	------	2.45	------

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* Wines sent for examination. † Condensed must.

RECORD OF TREATMENT.

No. 681. *Burger*, from Margherita Vineyard, Fresno. Received August 31, 1887, in good condition. The bunches were large, well filled, and without coulure; the berries were large, thick-skinned, and with good acid. The must showed 23.24% of solid contents by spindle and 0.45% of acid. The temperature of the grapes at crushing was 69°, and the maximum reached was 78°, on the fifth day. The wine was dry on the tenth day, and was drawn off.

At three weeks the wine was drawn off the thick lees, and a month later it was clear, with some aroma and pleasing quality. At three months an examination of the lees showed them not to be quite sound, so the wine was drawn off and pasteurized. At nine months the wine was bright, and had developed some bouquet, but was not quite clean-tasting. At this time it was racked again.

No. 692. *Burger*, from R. Wegener, Livermore. Received October 1, 1887, in good condition. But few of the bunches were compact, many of them showing coulure; the berries were generally small, and very sweet. The must showed 22.87% of solid contents by spindle and 0.62% of acid. The temperature of the grapes at crushing was 73°, and the maximum reached was 86°, on the eighth day. The fermentation was complete on the thirteenth day, when the wine was drawn off.

At three months the wine was bright, and showed better aroma but less body than No. 681, the Fresno sample. Two weeks later it was racked again. At seven months, as the lees showed some unsound germs, the wine was drawn off and pasteurized. At eight months it was bright, light-bodied, with some bouquet, but flat and neutral, and generally inferior to the Fresno sample.

No. 748. *Burger*, from J. T. Doyle, Cupertino. Received October 19, 1887, in good condition. The grapes were from long-pruned vines. The bunches were large, well filled, and showed no coulure; the berries were sweet, thin-skinned, and many bronzed by the sun. The must showed 19.4% of solid contents by spindle and 0.65% of acid. The temperature of the grapes at crushing was 61°, and the maximum reached was 83°, on the second day.

In sixteen days the wine was drawn off the lees, and at seven weeks it was clear, with medium acid, but watery and without aroma. Two weeks later it was racked again. At six months the sediment showed unsound ferments, and was racked off and pasteurized. At eight months the wine was bright and very much improved; it had developed some bouquet, and was a good wine for a Burger.

No. 754. *Burger*, from J. T. Doyle, Cupertino. Received October 20, 1887, in good condition. The grapes were from short-pruned vines. The bunches were of extremely large size; the berries very large, juicy, and much more agreeably flavored than the grapes from long-pruned vines. The must showed 21.98% of solid contents by spindle and 0.81% of acid. The temperature of the grapes at crushing was 71°, and the maximum reached was 86°, on the third day. In two weeks the wine was quite dry, and was drawn from the lees.

At two months the wine was clear, with fair aroma, medium acid, somewhat thin, but of fair quality Ten weeks later it had a suspicious taste, so it was drawn off and pasteurized. At eight months it was bright, with well-developed bouquet, of fair body, and slightly sharp acid.

No. 830. *Burger*, from Margherita Vineyard, Fresno. Received September 8, 1888, in excellent condition. The bunches were large and full; the berries juicy and very sweet, with moderately thick and rather tough skin. The must showed 23.16% of solid contents by spindle and 0.34% of acid. The temperature of the grapes at crushing was 69°, and the maximum reached was 81.5°, on the sixth day. On the twelfth day the fermentation was over, and the wine was drawn off.

At seven weeks the wine was racked again and taken to the cellar. At four months the wine was not clear, but it tasted good. Two months later it was racked again, and an examination of the lees showed no unsound germs. After this the wine did not improve much, but became clear. At seventeen months it was bright, and showed some bouquet; after this it deteriorated. At twenty-three months it was put in glass. At twenty-nine months the wine bottled at fifteen months was not quite bright, and was of poor quality; that bottled at twenty-three months was bright, and of better quality. The former did not improve in glass, but the latter nineteen months later was of fair quality, sound, bright, and drinkable.

No. 940. *Burger*, from J. T. Doyle, Cupertino. Received October 26, 1888, in good condition. The grapes were partly from long-pruned and partly from short-pruned vines. Those from the short-pruned vines were the best and showed the less coulure. The must showed 19.13% of solid contents by spindle and 0.31% of acid for the short-pruned, and 19.3% of solid contents by spindle and 0.63% of acid for the long-pruned. The temperature of the grapes at crushing was 67°, and the maximum reached was 83.5°, on the second day. On the tenth day the fermentation was over, and the wine was drawn off.

At two months the wine was clear, of somewhat better aroma than the Burger from Fresno, but light and thin. Two months later an examination of the lees showed them to be sound. At eleven months the wine was in good condition, and rather agreeable. Six months later the lees showed many old bitter ferments; the wine was bright, but had a slightly bitter flavor and had deteriorated since the last tasting; it was racked and part put in bottle. At twenty-two months the lees showed no bad germs; the wine was in good condition, of agreeable flavor, medium acid, poor aroma, fair quality, and mature. A month later it was put in bottle. At two years and four months the wine bottled at seventeen months was bright, with light deposit in bottle, no bouquet, little flavor, rather fresh, and agreeable. That bottled at twenty-three months was bright, but tasted as if exhausted, and lacked the freshness of the other.

No. 1165. *Burger*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 15, 1889, in fair condition. The bunches were large, cylindrical, compact; the berries over average in size, irregular, soft, juicy, and watery-tasting. The must showed 20.1% of solid contents by spindle and 0.63% of acid.

No. 1173. *Burger*, from Mission San José. Received October 16, 1889, in fair condition. The bunches were large and very compact, maturity complete. The must showed 21.2% of solid contents by spindle and 0.47% of acid. The temperature of the grapes at crushing was 63.5°, and the maximum reached was 81.5°, on the third day. On the fifth day the wine was drawn off, being quite dry.

At two months the wine was not quite clear; it showed medium acidity and body, fair quality, but was lacking in flavor and aroma. At this time it was racked for the second time and taken to the cellar. Six weeks later it had improved very much; it was bright, but lacked character. Four months later it showed signs of unsoundness, and was pasteurized. Tastings at eight and at ten months showed improvement and the development of some bouquet. After this the wine deteriorated, and showed that it had attained its maturity at from ten to twelve months.

No. 1279. *Burger*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 2, 1890, in good condition. The bunches and grapes were large and fine, but the latter were not quite ripe. The must showed 19.3% of solid contents by spindle.

No. 1383. *Burger*, from Mission San José. Received October 20, 1890, in a somewhat bruised condition and a little moldy. The must showed 20.2% of solid contents by spindle. The fermentation lasted seven days, with a maximum temperature of 80° on the fourth day.

The wine was racked twice during the first month, but did not clear very quickly. At one month it was a light, pleasant wine, but not quite clear, and with a slight taste of mold. The lees were examined at intervals, but no unsound germs were found. At three months the wine was clear, and was racked; it had a light, pleasant bouquet, somewhat disguised by moldiness. At eighteen months the wine tasted mature, so part was bottled, the remainder being bottled at two years. Fourteen months after the second bottling, both samples were tasted; they were both bright, and the second a very agreeable wine, but lacking in bouquet; the first was not quite clean-tasting.

No. 1449. *Burger*, from Tulare station. A sample for must analysis arrived August 29, 1891, in good condition, but not mature. The must showed 21.5% of solid contents by spindle.

No. 1539. *Burger*, from Paso Robles station. A sample for must analysis was received October 8, 1891, in good condition. The bunches were of medium size, well filled, with medium-sized berries. The must showed 23.7% of solid contents by spindle.

No. 1565. *Burger*, from Mission San José. Received October 9, 1891, in fair condition. The must showed 20.6% of solid contents by spindle. The fermentation was slow and cool, lasting ten days, and remaining at its maximum temperature of 77° from the fourth to the sixth day.

In six weeks the wine was clear and clean-tasting. It was racked twice during the first three months, and at five months was bright, without much bouquet or flavor, but clean-tasting and with full and agreeable acid. At eight months it was smooth and pleasing, and had developed well. At fifteen months it was mature, in good order, a very pleasing wine, but with little character; at this age it was bottled.

No. 1644. *Burger*, from Paso Robles station. A sample for must analysis was received September 16, 1892, in good condition. The must showed 19.05% of solid contents by spindle.

No. 1660. *Burger*, from Amador station. A sample for must analysis was received September 19, 1892, in poor condition. The must showed 21.1% of solid contents by spindle.

No. 1667. *Burger*, from Tulare station. A very fine lot of grapes was received September 19, 1892, in good condition. The must showed 19.6% of solid contents by spindle. The must fermented well and reached its maximum temperature of 80° on the fourth day.

In one month the wine was dry, clear, and clean-tasting; it was racked twice during the first two months. At four months the wine was bright, smooth, and fresh-tasting, but lacking in bouquet. At nine months the wine was in good order, and, though lacking in delicacy, the best of the Tulare white wines of this year. After this the wine deteriorated.

No. 1773. *Burger*, from Mission San José. Received October 15, 1892. The must showed 20.7% of solid contents by spindle. The fermentation was rather slow in starting, as the grapes were crushed at 58°; it reached its maximum temperature of 79° on the fourth day, and continued about eleven days, when the wine was nearly dry.

In three weeks the wine was nearly clear and quite dry; it was racked twice during the first two months, and at three months was bright, clean-tasting, and with full acid. Tastings at five, eight, ten, and thirteen months showed a gradual improvement and the development of a little bouquet. The wine kept well, and while lacking in character was clean-tasting and pleasant.

No. 1839. *Burger*, from Amador station. Received September 8, 1893, in good condition. The grapes were generally of good size, but some bunches had many abortive berries; they were not mature. The must showed 15.2% of solid contents by spindle.

No. 1861. *Burger*, from Amador station. Another sample for must analysis arrived September 15, 1893, in good condition, but not mature. The bunches were large, and the berries very irregular in size. The must showed 17.7% of solid contents by spindle.

No. 1908. *Burger*, from Tulare station. Received October 5, 1893, in good condition, except for a few moldy bunches. The bunches and berries were very large and well ripened. The must showed 20.0% of solid contents by spindle. The fermentation was quick and thorough, reached its maximum temperature of 89° on the third day, and was through on the fifth.

At the end of the first month the wine was nearly clear, dry, and clean-tasting. Tastings at four, six, and eight months showed a general toning-down and increase of brightness, but the wine was completely neutral and almost without flavor or bouquet.

No. 2008. *Burger*, from Paso Robles station. Received October 26, 1893, in good condition. The bunches were large, irregular, loose, but well filled; the berries a little over medium in size. The grapes were quite mature. The must showed 22.05% of solid contents by spindle. The fermentation lasted nine days, and was cool, the temperature never going above 75°.

The wine cleared quickly, and was racked twice during the first two months. At seven months the wine was bright, clean-tasting, with moderate acid and neutral flavor.

No. 2061. *Burger*, from Mission San José. Received November 1, 1893, in good condition, and mature. The must showed 22.6% of solid contents by spindle. The fermentation was slow and cool, reaching its maximum temperature of 78° on the fourth day.

The wine became bright soon after the first racking, and at three months after crushing was a clean-tasting, neutral wine, with full acid.

No. 2085. *Burger*, from J. T. Doyle, Cupertino. A sample for must analysis arrived November 6, 1893, in good condition. The must showed 17.2% of solid contents by spindle.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF WHITE SOUTHERN FRENCH TYPE.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at Six to Eight Months	Body
	Clairette blanche.								
264	Natoma	1884	21.34	21.07	.45	.31	13.00	.43	1.85
481	Mission San José	1886	17.50	17.22	.53	.28	8.85	.55	2.10
510	Mission San José	1886	20.00	------	.87	------	------	------	------
513	Mission San José	1886	19.30	------	.56	------	8.61	.47	1.58
535	Mission San José	1886	21.50	20.76	.86	.36	10.00	.51	1.80
535*a*	Mission San José	1886	21.50	20.76	.86	.36	9.82	.57	1.92
771	Mission San José	1887	25.45	25.20	.45	.35	12.36	.61	2.20
948	Mission San José	1888	23.32	22.22	.26	.28	11.27	.55	1.80
1170	Mission San José	1889	22.40	22.67	.41	.35	11.55	.40	2.55
1420	Mission San José	1890	26.30	------	.54	.21	13.27	.42	2.78
2065	Mission San José	1893	24.80	------	.54	------	------	------	------
2225	Mission San José	1894	20.60	19.21	.62	------	------	.64	------
2345	Mission San José	1894	20.85	------	.39	------	------	------	------
1196	Cupertino	1889	18.15	17.17	.34	.45	8.70	.42	1.35
1398	Cupertino	1890	21.10	------	.53	------	------	------	------
2029	Cupertino	1893	22.40	------	.50	------	------	------	------
1543	Paso Robles	1891	24.80	------	.45	------	------	------	------
1748	Paso Robles	1892	22.20	------	.32	------	------	------	------

Summary of Analyses of Musts and Wines of White Southern French Type—Cont'd.

Number	Locality.	Vintage of	Must.				Wine.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at Six to Eight Months	Body
	Clarette blanche—Cont.								
1658	Amador station	1892	22.70	------	.46	------	------	------	------
1838	Amador station	1893	18.00	------	.71	------	------	------	------
1862	Amador station	1893	21.70	------	.56	------	------	------	------
2192	Amador station	1894	24.15	------	.39	------	------	------	------
1701	Tulare	1892	22.40	------	.29	------	------	------	------
1969	Tulare	1893	22.90	21.38	.38	.30	11.45	.53	2.20
2339	Tulare	1894	25.00	------	.34	------	------	------	------
	Average, Mission San Jose	------	**22.05**	**21.15**	**.57**	**.31**	**10.71**	**.52**	**2.09**
	Average, Cupertino	------	**20.55**	**17.17**	**.45**	**.45**	**8.70**	**.42**	**1.35**
	Average, Paso Robles	------	**23.50**	------	**.38**	------	------	------	------
	Average, Amador station	------	**21.64**	------	**.53**	------	------	------	------
	Average, Tulare	------	**23.43**	**21.38**	**.33**	**.30**	**11.45**	**.53**	**2.20**
	Marsanne.								
1412	Cupertino	1890	24.10	------	.66	.27	12.82	.50	2.50
2097	Cupertino	1893	25.90	------	.63	------	------	------	------
1619	Tulare	1892	25.65	23.67	.38	.45	*22.18	.43	3.66
2000	Tulare	1893	26.10	25.76	.41	.50	12.73	.43	2.90
2203	Tulare	1894	27.35	------	.26	------	------	------	------
1856	Amador station	1893	23.70	------	.48	------	------	------	------
2162	Amador station	1894	26.70	------	.34	------	------	------	------
1960	Paso Robles	1893	24.10	------	.24	------	------	------	------
	Average, Cupertino	------	**25.00**	------	**.64**	**.27**	**12.82**	**.50**	**2.50**
	Average, Tulare	------	------	**24.71**	**.35**	**.47**	**12.73**	**.43**	**2.90**
	Average, Amador station	------	**25.20**	------	**.41**	------	------	------	------
	Chasselas doré.								
476	Cupertino	1886	17.50	------	.40	.25	8.61	.41	------
696	Cupertino	1887	23.17	23.61	.31	.33	11.64	.53	1.87
917	Cupertino. (Short-pruned)	1888	22.89	24.12	.20	.50	11.45	.38	2.25
918	Cupertino. (Long-pruned)	1888	22.24	22.67	.22	.33			
1267	Cupertino	1890	22.30	------	.44	.29	------	------	------
2086	Cupertino	1893	23.10	------	.53	------	------	------	------
1112	Mission San José	1889	22.60	21.80	.25	.38	11.45	.28	2.28
1260	Mission San José	1890	21.93	------	.40	.26	------	------	------
1561	Mission San José	1891	22.15	------	.40	------	11.45	.39	1.80
1776	Mission San José	1892	20.85	21.38	.37	------	11.00	.53	2.10
1948	Mission San José	1893	23.70	------	.46	------	------	------	------
2247	Mission San José	1894	21.90	------	.35	------	------	------	------
1448	Tulare	1891	24.53	------	.18	------	------	------	------
1677	Tulare	1892	20.20	------	.29	------	9.90	.40	2.70
2324	Tulare	1894	22.15	------	.21	------	------	------	------
	Average, Cupertino	------	------	**23.46**	**.34**	**.36**	**11.54**	**.45**	**2.06**
	Average, Mission San Jose	------	**22.19**	**21.59**	**.37**	**.32**	**11.30**	**.40**	**2.06**
	Average, Tulare	------	**22.29**	------	**.23**	------	**9.90**	**.40**	**2.70**
	Ugni blanc.								
274	Natoma	1884	20.70	20.61	.59	.49	11.10	.51	2.00
785	Cupertino	1887	21.46	20.99	.87	.47	9.63	.56	2.60
954	Cupertino	1888	19.75	20.03	.50	.37	9.73	.45	2.30
1195	Cupertino	1889	22.80	21.80	.51	.29	11.45	.39	2.00
1405	Cupertino	1890	23.05	------	.91	.34	11.27	.74	1.54
2026	Cupertino	1893	22.40	------	1.00	------	------	------	------
1704	Tulare	1892	22.15	------	.45	------	------	------	------
2352	Tulare	1894	23.30	------	.36	------	------	------	------
1737	Paso Robles	1892	24.20	------	.51	------	------	------	------
	Average, Cupertino	------	**21.89**	**20.94**	**.76**	**.36**	**10.52**	**.53**	**2.11**
	Average, Tulare	------	**22.72**	------	**.40**	------	------	------	------

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*Fortified.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF WHITE SOUTHERN FRENCH TYPE—Cont'd.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at Six to Eight Months	Body
	Verdal.								
367	Patchen	1885	14.91	------	.53	.26	8.07	.52	1.80
585	Patchen	1886	17.00	15.11	.63	.47	8.46	.55	1.55
512	Livermore	1886	21.80	21.07	.38	.30	10.36	.41	1.80
701	Livermore	1887	22.84	23.22	.52	.37	10.75	.43	2.60
803	Glenwood	1887	20.65	20.10	.75	.40	------	------	------
1164	Cupertino	1889	21.50	------	.48	------	------	------	------
1361	Cupertino	1890	18.95	------	.84	.22	9.73	.46	1.80
1188	Mission San José	1889	19.50	------	.57	------	------	------	------
1430	Mission San José	1890	22.15	------	.63	------	------	------	------
2233	Mission San José	1894	20.40	------	.53	------	------	------	------
1453	Tulare	1891	18.82	18.30	.53	------	8.07	.40	2.60
1705	Tulare	1892	20.40	19.75	.42	.43	11.00	.46	2.30
1912	Tulare	1893	18.80	17.70	.75	.39	9.27	.48	2.60
1982	Tulare	1893	19.30	18.46	.58	.25	9.54	.45	2.60
2342	Tulare	1894	19.30	17.99	.59	------	------	------	------
1964	Paso Robles	1893	22.85	------	.52	------	------	------	------
2082	Paso Robles	1893	22.70	21.63	.51	.37	10.12	.51	2.25
	Average, Patchen	------	**15.95**	**15.11**	**.58**	**.36**	**8.25**	**.53**	**1.67**
	Average, Livermore	------	**22.32**	**22.14**	**.45**	**.33**	**10.55**	**.42**	**2.20**
	Average, Cupertino	------	**20.22**	------	**.66**	**.22**	**9.73**	**.46**	**1.80**
	Average, Mission San Jose	------	**20.68**	------	**.57**	------	------	------	------
	Average, Tulare	------	**19.32**	**18.44**	**.57**	**.35**	**9.47**	**.47**	**2.52**
	Average, Paso Robles	------	**22.77**	**21.63**	**.51**	**.37**	**10.12**	**.51**	**2.25**
	Chauché gris.								
92	St. Helena	1883	20.94	21.38	.51	.33	12.54	.68	1.42
93	Glenwood	1883	18.96	19.89	.52	.29	11.54	.60	1.53
359	Glenwood	1885	22.80	------	.41	.28	13.00	.35	1.80
117	Fresno	1884	------	------	------	------	11.45	.66	2.05
682	Fresno	1887	24.80	24.12	.57	.40	13.27	.50	2.80
1030	Fresno	1889	31.10	30.63	.60	.91	------	------	------
1096	Fresno	1889	28.00	27.75	.37	.59	16.20	.30	3.35
1207	Fresno	1890	22.82	22.67	.48	.50	11.18	.22	2.15
489	Cupertino	1886	20.90	20.65	.50	.36	10.17	.55	1.80
694	Cupertino. (Long-pruned)	1887	25.13	26.31	.50	.39	13.36	.43	2.50
707	Cupertino. (Short-pruned)	1887	28.78	28.33	.45	.40	------	------	------
882	Cupertino. (Long-pruned)	1887	23 32	23.62	.32	.41	12.09	.53	2.00
883	Cupertino. (Short-pruned)	1888	24.92	26.00	.29	.49			
·1101	Cupertino	1889	25.55	------	.39	------	------	------	------
1286	Cupertino	1890	25.44	------	.36	------	------	------	------
2096	Cupertino	1893	25.20	------	.36	------	------	------	------
540	Patchen	1886	22.00	21.38	.43	.41	10.91	.38	1.90
839	Mission San José	1887	25.52	------	.42	------	------	------	------
1084	Mission San José	1889	25.90	25.76	.48	.50	13.18	.37	2.45
1509	Mission San José	1891	25.40	25.76	.44	------	13.09	.30	2.45
1774	Mission San José	1892	24.80	23.60	.44	------	11.91	.60	2.50
1987	Mission San José	1893	25.95	25.19	.52	------	14.00	.58	2.60
2240	Mission San José	1894	25.85	------	.48	------	------	------	------
1499	Asti, Sonoma County	1891	24.80	24.12	.41	.28	------	------	------
1495	Paso Robles	1891	25.20	------	.38	------	------	------	------
1649	Paso Robles	1892	25.20	------	.45	------	------	------	------
1864	Paso Robles	1893	23.30	22.60	.50	.36	11.27	.49	2.30
1801	Amador station	1893	21.30	------	.72	------	------	------	------
2145	Amador station	1894	25.50	------	.45	------	------	------	------
	Average, Glenwood	------	**20.88**	**19.89**	**.46**	**.28**	**12.27**	**.47**	**1.67**
	Average, Fresno	------	**26.68**	**26.29**	**.50**	**.60**	**13.02**	**.42**	**2.59**
	Average, Cupertino	------	------	**24.98**	**.39**	**.41**	**11.87**	**.50**	**2.10**
	Average, Mission San Jose	------	**25.59**	**25.08**	**.48**	**.50**	**13.04**	**.46**	**2.50**
	Average, Paso Robles	------	**24.57**	**22.60**	**.44**	**.36**	**11.27**	**.49**	**2.30**

SUMMARY OF ANALYSES OF MUSTS AND WINES OF WHITE SOUTHERN FRENCH TYPE—Cont'd.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at Six to Eight Mos.	Body
	Burger.								
112	Fresno	1883	------	------	------	------	11.36	.49	2.24
113	Fresno	1884	------	------	------	------	11.17	.50	3.02
261	Fresno	1884	20.06	19.96	.45	.45	10.63	.53	1.65
681	Fresno	1887	23.24	22.67	.45	.53	12.36	.50	2.60
830	Fresno	1888	23.16	24.11	.34	.60	11.55	.58	2.10
114	San Gabriel	1884	------	------	------	------	11.42	.40	2.16
261	San Gabriel	1884	19.19	19.15	.54	.31	10.50	.60	2.05
348	Vina	1885	23.35	------	.39	.60	12.00	.68	2.69
471	Vina	1886	22.50	------	.50	.48	10.25	.75	1.80
362	Lower Lake	1885	22.69	------	.47	.40	11.00	.54	1.68
349	Harrisburg	1885	19.46	------	.80	.30	10.16	.65	1.93
366	Patchen	1885	12.62	------	.75	.32	6.00	.48	1.52
572	Sacramento	1886	24.00	24.33	.39	.39	------	------	------
508	Livermore	1886	20.80	20.24	.44	.37	9.90	.40	2.05
692	Livermore	1887	22.87	22 67	.62	.42	11.18	.50	2.30
501	Cupertino	1886	13.10	11.68	1.02	.09	5.00	.79	1.30
748	Cupertino. (Long-pruned)	1887	19.40	19.21	.65	.33	9.90	.54	2.10
754	Cupertino. (Short-pruned)	1887	21.98	21.63	.81	.37	11.45	.66	2.30
940	Cupertino. (Short-pruned)	1888	19.13	19.75	.31	.39	9.54	.55	1.40
941	Cupertino. (Long-pruned)	1888	19.30	19.54	.63	.45			
1165	Cupertino	1889	20.10	------	.63	------	------	------	------
1279	Cupertino	1890	19.30	------	.87	------	------	------	------
2085	Cupertino	1893	17.20	------	.99	------	------	------	------
1173	Mission San José	1889	21.20	21.55	.47	.32	10.42	.43	2.35
1383	Mission San José	1890	20.20	------	.68	.34	11.45	.50	2.44
1565	Mission San José	1891	20.60	------	.68	------	10.91	.62	2.32
1773	Mission San José	1892	20.70	19.21	.79	------	11.00	.55	2.20
2061	Mission San José	1893	22.60	21.63	.79	.23	11.64	.71	2.15
2241	Mission San José	1894	18.80	------	.69	------	------	------	------
1449	Tulare	1891	21.50	------	.53	------	------	------	------
1667	Tulare	1892	19.60	------	.56	.36	9.73	.51	2.35
1908	Tulare	1893	20.00	19.21	.75	.44	9.70	.45	2.60
2333	Tulare	1894	21.90	20.10	.55	------	10.17	.39	2.45
1539	Paso Robles	1891	23.70	------	.45	------	------	------	------
1644	Paso Robles	1892	19.05	------	.80	------	------	------	------
2008	Paso Robles	1893	22.05	21.40	.45	.39	11.00	.45	2.30
2217	Paso Robles	1894	22.80	------	.68	------	------	------	------
1660	Amador station	1892	21.10	------	.60	------	------	------	------
1839	Amador station	1893	15.20	------	.91	------	------	------	------
1861	Amador station	1893	17.70	------	.90	------	------	------	------
2190	Amador station	1894	24.35	------	.38	------	------	------	------
2315	Amador station	1894	25.40	------	.41	------	------	------	------
	Average, Fresno	------	**22.48**	**22.24**	**.41**	**.52**	**11.41**	**.32**	**2.32**
	Average, Livermore	------	**21.83**	**21.45**	**.52**	**.39**	**10.54**	**.45**	**2.17**
	Average, Cupertino	------	**19.48**	**20.03**	**.69**	**.38**	**10.29**	**.58**	**1 93**
	Average, Mission San Jose	------	**20.70**	**20.79**	**.68**	**.29**	**11.08**	**.56**	**2.29**
	Average, Tulare	------	**20.75**	**19.65**	**.59**	**.40**	**9.85**	**.45**	**2.46**
	Average, Paso Robles	------	**21.90**	**21.40**	**.57**	**.39**	**11.00**	**.45**	**2.30**
	Average, Amador station	------	**20.75**	------	**.65**	------	------	------	------

AUSTRIAN AND HUNGARIAN TYPE—WHITE.

Throughout the vine-growing parts of Austria and Hungary, large quantities of light white wines are made, which are much appreciated for local consumption. The principal grapes used for this purpose are the Rother Steinschiller and the Slankamenka, for the mildest and lightest wines. These grapes average about 20% of sugar with 0.50% of acid. In California they show similar character, though the Slankamenka attains more sugar as a rule. Better, but still light and neutral wines are made from Wälschriesling, Velteliner, Rothgipfler, and Peverella. These are all promising for California, and are worthy of more extended trial. The finest wines of Austro-Hungary are made, generally, from the same grapes as those of Germany. The higher class of white grapes of France have also been introduced, and are cultivated with success. The Furmint or Gelber Mosler is extensively grown. In most places it makes a white wine of good medium quality; but in favored locations, such as that of Tokay, it makes wines of world-wide reputation.

The importance of testing the vines of this type will be realized when it is remembered that the production of wine in Austro-Hungary is second only to that in France, and for awhile exceeded it, after the advent of the phylloxera.

WÄLSCHRIESLING.

Description.—Vine small and not very vigorous; canes smooth, slender, with small and rather close joints; leaves five-lobed, of medium size, with well-marked and more or less deep sinuses, long, acute teeth, upper sinuses closed, the rest open, young leaves woolly, becoming glabrous; bunches small, conico-cylindrical, very slightly shouldered, sometimes double, rather close, on long, occasionally branched peduncles; berries small, round, juicy, with tender skin, varying in color from green to golden. The grapes ripen about the same time as the Johannisberg Riesling.

The Wälschriesling is said to have come originally from the Champagne district of France, and spread through southern Germany to Austria. What its name was (or is) in its original habitat has not been determined; its fruit resembles somewhat that of the Chardonay, but its leaves are very distinct. At present it is grown extensively in eastern Switzerland, Styria, and parts of lower Austria and Hungary. It succeeds best on warm, loose hillsides where the soil is fairly rich. In Austria it has the reputation of being the steadiest and heaviest bearer of any grapes capable of producing a good white wine. It has thus far not shown itself remarkable in this respect in California, but it is doubtful if it has yet been planted in the most suitable situations. It gives a wine of neutral character, resembling that of the true Riesling, except in its lack of special aroma. It is excellent for blending, and might advantageously be planted in association with the Johannisberg Riesling to offset the small bearing of the latter.

ANALYSES OF MUSTS AND WINES.

WÄLSCHRIESLING.	Date of Picking	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six to Eight Months	Body
						By Weight	By Volume		
1889—No. 1158. Cupertino	Oct. 9	23.50	23.13	.36	.29	10.81	13.27	.36	1.85
1890—No. 1240. Margherita Vineyard, Fresno	Aug. 23	26.90	27.13	.39	.40	11.15	13.64	.50	2.08
No. 1309. Mission San José	Oct. 5	21.70	------	.57	.27	8.91	11.09	.34	1.90
1891—No. 1550. Paso Robles	Oct. 6	26.35	------	.40	---	------	------	------	------
1892—No. 1741. Paso Robles	Oct. 11	25.20	------	.43	---	------	------	------	------
1893—No. 1806. Amador station	Sept. 1	20.00	------	.86	---	------	------	------	------
No. 1886. Paso Robles	Sept. 19	26.00	------	.45	---	------	------	------	------
No. 1915. Paso Robles	Oct. 5	26.70	26.31	.41	.40	10.81	13.27	.30	2.30
No. 2028. Cupertino	Oct. 31	23.70	------	.75	---	------	------	------	------
1894—No. 2142. Amador station	Sept. 13	27.20	------	.44	---	------	------	------	------

RECORD OF TREATMENT.

No. 1158. *Wälschriesling*, from J. T. Doyle, Cupertino. The grapes arrived October 10, 1889, in good condition, and were crushed the same day, the juice showing 23.50% of solid contents. The bunches were small, cylindrical, and close, with a distinct wing attached to nearly every one; grapes small and round, skin thin and tender, yellowish-green in color, with a brown spot at the end of each grape; flesh soft and juicy, sweet, and without special flavor; it corresponded exactly with Goethe's description, except that the bunches were very small. Fermentation commenced October 11th at 77°, and reached its maximum on October 13th at 81°. On October 17th the wine was dry. From 103.5 lbs. were obtained 7.31 gals., corresponding to 141.4 gals. per ton; pomace, 22.7%; stems, 5.8%.

In seven weeks after crushing the wine was bright, with a very light color, very strong bouquet, agreeable flavor, clean and developed taste; its acid, body, and alcohol were adequate, and quality good. A week later it was racked and taken to the cellar. At fourteen weeks it was still bright, but the bouquet had diminished somewhat; quality was good, but its taste still raw; lees sound. At six and one half months it was racked again. At eight months the wine was bright, with a marked bouquet, an agreeable flavor, but somewhat spoiled by slight taste of mold; quality good.

No. 1240. *Wälschriesling*, from Margherita Vineyard, Fresno. Received August 26, 1890, in good condition, and mature. The bunches were small, conico-cylindrical, very slightly shouldered, sometimes double, rather close; the berries were small, round, soft, and juicy, with tender skin, varying in color from green to golden. The must showed 26.9% of solid contents by spindle. The fermentation attained its maximum temperature of 81° on the third day, and after that continued slowly for over a month.

At the end of a month the wine was still cloudy and fermenting, and was racked for the second time. At the end of ten weeks it showed some good qualities, but had a suspicious taste. The lees showed a few lactic ferments. A month later the lactic taint was beginning to be noticeable to the taste, and the wine was pasteurized. At the end of nine months it was bright, but not clean-tasting. After this it changed very little, and was racked three times before it was bottled at seventeen months.

No. 1309. *Wälschriesling*, from J. T. Doyle, Cupertino. Received October 8, 1890, in bad condition, many of the grapes moldy. The must showed 21.7% of solid contents by spindle. The fermentation was cool, and lasted nine days; the maximum temperature reached was 73°, on the fourth day.

The wine was racked three times during the first four months, but was somewhat slow in clearing. At five months the lees showed some lactic ferments and the odor was slightly affected, so the wine was pasteurized. Two months later the wine was clear and free from lactic taste; it had a pleasing flavor and some bouquet. At fifteen months it was bright and much improved, with good flavor, some bouquet, and good body. At seventeen months it was mature, and was racked for the fifth time, and some of it bottled. The rest was bottled at twenty-three months. At three years both bottlings were in excellent condition, not highly flavored, but good wines; the last bottled was the brighter and cleaner-tasting.

No. 1550. *Wälschriesling*, from Paso Robles station. A sample for must analysis arrived October 8, 1891, in good condition, and mature; the bunches were small and compact. The must showed 26.35% of solid contents by spindle.

No. 1741. *Wälschriesling*, from Paso Robles station. A sample for must analysis arrived October 13, 1892, in good condition. The must showed 25.2% of solid contents by spindle.

No. 1806. *Wälschriesling*, from Amador station. A sample for must analysis arrived September 1, 1893, in good condition. The bunches were small and compact, the berries small. The grapes were not quite mature. The must showed 20.0% of solid contents by spindle.

No. 1886. *Wälschriesling*, from Paso Robles station. This sample was received September 21, 1893, under the name of Blue Portuguese, but appeared to be identical with Wälschriesling. The grapes were in good condition, and the must showed 26.0% of solid contents by spindle.

No. 1915. *Wälschriesling*, from Paso Robles station. Received October 7, 1893, in good condition. The bunches were small, cylindrical, very compact, sometimes with a small wing; the berries small, round, thin-skinned, and juicy. The grapes were quite mature and commencing to shrivel. The must showed 26.7% of solid contents by spindle. The fermentation lasted nine days, and reached its maximum temperature of 78° on the second day.

At one month the wine was clear and clean-tasting, without any special flavor. At three months it had been racked three times, and was bright, heavy-bodied, without much character, and lacking in freshness. At seven months it showed little change, and was lacking in acid.

No. 2028. *Wälschriesling*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 31, 1893, in good condition. The bunches were of medium size, very irregular, branching, and well filled; the berries small, juicy, without special flavor, mature. The must showed 23.7% of solid contents by spindle.

GRÜNER VELTELINER.

Synonyms: Valtelliner; Valtellin; Veltliner; St. Valentin; Weissgipfler.

Description.—Vine vigorous, with medium-sized, rather short-jointed canes; leaves of medium size or larger, generally rather deeply five-lobed, but occasionally almost without sinuses, dark-green and glabrous above, loose-woolly below, teeth sharp and unequal; bunches of medium size or larger, conico-cylindrical, winged, close, but not compacted; berries small to medium, nearly round or slightly ovoid, juicy, thick-skinned, without special flavor, and late in ripening.

The Red Velteliner seems to have come originally from the province of Valtellina, in upper Italy, where it is still widely cultivated, being adapted to high altitudes. It is now widely spread over Austria and parts of Germany, and is considered a valuable grape.

The Grüner Velteliner, which differs materially from the other Velteliners, and in botanical characters approaches more nearly to the Rothgipfler, is not so widespread, but is common in lower Austria. The latter grape, which is the only one planted at the stations, has done well wherever tried. It is rather late in ripening, but has always developed a full amount of sugar, together with an adequate acidity. This is true even at Fresno, where the must has averaged 0.51% of acid with 26.3% of sugar. The average must composition, for six years, of grapes of this variety grown at Cupertino and at Mission San José has been 25.1% of sugar and 0.52% of acid. The wine is neutral in character, and requires the addition of some more aromatic grape for the production of a fine white wine. The vine bears well with short-pruning.

ANALYSES OF MUSTS AND WINES.

GRÜNER VELTELINER.	Date of Picking	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six to Eight Months	Body
						By Weight	By Volume		
1889—No. 1108. J. T. Doyle, Cupertino	Sept. 26	25.60	25.76	.46	.40	10.35	12.82	.48	2.55
1890—No. 1208. Margherita Vineyard, Fresno	Aug. 12	23.30	22.23	.53	.40	9.20	11.45	.32	1.80
No. 1306. J. T. Doyle, Cupertino	Oct. 7	25.90	------	.54	.33	------	------	------	------
No. 1346. J. Gallegos, Mission San José	Oct. 11	25.20	------	.51	.30	11.23	13.73	.47	2.58
1891—No. 1454. Fresno	Aug. 28	26.60	------	.48	----	10.35	12.82	.44	2.95
No. 1605. Mission San José	Oct. 25	23.50	24.12	.53	----	9.63	12.00	.40	2.15
1892—No. 1784. Mission San José	Oct. 20	24.25	------	.55	----	------	------	------	------
1893—No. 1803. Amador station	Aug. 29	19.30	------	.87	----	------	------	------	------
No. 1989. J. Gallegos, Mission San José	Oct. 19	24.80	23.61	.60	----	10.63	13.09	.57	2.30
No. 2101. J. T. Doyle, Cupertino	Nov. 6	28.00	------	.51	----	------	------	------	------
1894—No. 2252. Mission San José	Oct. 5	23.50	------	.49	----	------	------	------	------

RECORD OF TREATMENT.

No. 1108. *Grüner Velteliner*, from J. T. Doyle, Cupertino. This variety arrived in poor condition September 27, 1889, and was crushed the same day; the juice showed 25.6% of solid contents. The grapes resemble very much the Marsanne, both in bunches and leaves. Bunches branched and rather large, generally loose; grapes medium size and very slightly oval, varying in color from green to golden-yellow. Fermentation commenced September 28th, reached its maximum September 30th at 83.5°, and continued gently till October 5th, when the wine was dry. From 122 lbs. crushed, 8.62 gals. were obtained, corresponding to 141.6 gals. per ton.

At six weeks the wine was clear, with a light greenish-golden color, agreeable bouquet, clean, and fairly developed taste; acid and body adequate; general quality, very good. At two months it was racked and taken to the cellar. Seven weeks later the wine was clear, and its general effect very pleasant; bouquet not much developed, but agreeable; lees sound. In seven weeks it was racked again, and a month later the lees were found to be sound. At nine months from crushing the wine was bright, of a light, pleasing bouquet, and full, rich flavor, rather rough taste, full body and alcohol; quality good. At fifteen months the lees showed much *S. pastorianus* ferment. The wine was bright and with a delicate bouquet; as a whole, it was of very good quality and well matured at date. In a month it was bottled, and at seventeen months from crushing the wine was very good, but lacked in bouquet.

No. 1208. *Grüner Velteliner*, from Margherita Vineyard, Fresno. Received August 15, 1890, in good condition, and mature. The bunches were large to medium in size, very irregular in shape, generally conico-cylindrical, well shouldered or winged, often double, and varying from loose to well filled, but the berries never compressed; the berries were below average size, slightly oval, on long and slender pedicels; the flesh was crisp, juicy, and sweet, but without marked flavor. The must showed 23.3% of solid contents by spindle. The fermentation was cool and prolonged. The maximum temperature of 78° was reached on the fourth day, and the must continued to ferment slowly for about ten days.

At five weeks the wine was nearly clear, and was racked for the second time. At three months it had a pleasant flavor and a little bouquet, soft acid; quality in general fair, but the after-taste not good. At six months the wine had been racked three times; it was clear and of good flavor, and possessed a little bouquet; the lees showed some lactic germs, but the taste was unaffected; it was pasteurized for safety. At nine months it was bright and pleasing, but a little flat. At sixteen months it was bright and mature, and had been racked four times. At eighteen months it was bottled. Two years after bottling the wine was tasted and found to be bright, clean-tasting, and well matured, with little bouquet or flavor, but sound and drinkable.

No. 1306. *Grüner Velteliner*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 8, 1890, in fair condition. The must showed 25.9% of solid contents by spindle.

No. 1346. *Grüner Velteliner*, from Mission San José. Received October 14, 1890, in fair condition, with some rotten and moldy bunches. The must showed 25.2% of solid contents by spindle. The fermentation lasted eight days, and reached its maximum temperature of 77° on the third day.

At three weeks after crushing the wine was still cloudy and a little sweet. At seven weeks it was bright, very agreeably flavored, with medium acid and good body. At three months it had been racked twice, and was bright and sound, with a delicate bouquet, but a slightly smoky after-taste. It went on improving and maturing, and remained bright until the ninth month, when the lees showed a few lactic ferments, without the taste, however, being affected. At fourteen months it was clear, of good flavor, and with a little bouquet, but also with a faint suspicion of lactic taint in the after-taste. It was bottled two months later. At two years after bottling the wine was light, smooth, with good bouquet, but not quite clear or clean-tasting.

No. 1454. *Grüner Velteliner*, from Margherita Vineyard, Fresno. Received August 31, 1891, in good condition, and mature. The must showed 26.6% of solid contents by spindle. The fermentation reached its maximum temperature of 78° on the third day, and continued slowly for over two weeks.

At six weeks the wine was clear and dry, of good body and fairly agreeable, but with a somewhat doubtful after-taste. At four months the wine had been racked twice, and the lees showed a few long filaments; it was clear and of good bouquet and flavor, but the after-taste was not perfectly clean. It was racked twice more during the first year, and remained bright and matured well. At sixteen months it was bright, sound, and full-bodied. A month later it was bottled.

No. 1605. *Grüner Velteliner*, from Mission San José. Received October 28, 1891, in poor condition. The must showed 23.5% of solid contents by spindle. The fermentation lasted eight days, and reached its maximum temperature of 80° on the fourth day.

A month from crushing the wine was not quite clear, but full-flavored, smooth, and agreeable. At three months it was clear and very pleasing, but not quite clean-tasting. At six months it was clear and sound, but still raw. At eight months it had improved much, was bright, smooth, and aromatic, of good body and advanced development. At eleven months it was racked for the third time. At fifteen months it was in good condition and nearly mature. A month later it was bottled.

No. 1784. *Grüner Velteliner*, from Mission San José. Received October 21, 1892, in poor condition. The must showed 24.25% of solid contents by spindle. The grapes were fermented with No. 1783, Steinschiller.

No. 1803. *Grüner Velteliner*, from Amador station. A sample for must analysis arrived September 1, 1893, in good condition. The bunches were of medium size, the berries small. The must showed 19.3% of solid contents by spindle.

No. 1989. *Grüner Velteliner*, from Mission San José. Received October 19, 1893, in good condition. The bunches were from small to medium, conico-cylindrical, with a large or small wing, close, but not compacted, on slender peduncles; the berries were small, round, on very slender pedicels, soft, juicy, thin-skinned, without distinctive flavor. The grapes were quite mature. The must showed 24.8% of solid contents by spindle. The fermentation lasted six days, and reached its maximum temperature of 78° on the third day.

The wine continued fermenting gently for over a month, and was not quite clear or dry six weeks after crushing. At three months it was bright, of good bouquet and flavor, very fresh and clean-tasting, but without marked character. At seven months it had been racked three times, and tasted very smooth and agreeable.

No. 2101. *Grüner Velteliner*, from J. T. Doyle, Cupertino. A sample for must analysis arrived November 6, 1893, in good condition. The bunches were under medium size, conical, well filled, but not compact; the berries small, slightly elongated, juicy, thick-skinned, mature.

ROTHGIPFLER.

Synonym: Reifler.

Description.—Vine of medium size, hardy (and in Europe said to be very prolific); leaves of medium size, round, five-lobed, with somewhat shallow, open sinuses, teeth small; bunches of medium size, roundish, compact; berries small, round, juicy, with rather tough skin, and very much punctate. The grapes ripen rather late, and are of neutral flavor.

The Rothgipfler is a grape of lower Austria, where it is rather extensively planted, and whence it has spread into Bavaria and Würtemburg. It is prized in the vineyards of these countries, on account of its hardiness against extreme cold and heat, its fruitfulness, and the quality of its wines.

In California it has not maintained its reputation, especially in regard to its bearing qualities. The vine has been planted in Cupertino, Mission San José, Amador, and Paso Robles, but only once has produced enough for a wine-making test. The wine made showed more character than that of the Grüner Velteliner, but the must is in general lower in acidity.

ANALYSES OF MUSTS AND WINES.

ROTHGIPFLER.	Date of Picking	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six to Eight Months	Body
						By Weight	By Volume		
1889—No. 1105. J. T. Doyle, Cupertino	Sept. 26	28.20	28.07	.46	.34	11.46	14.00	.39	2.20
1890—No. 1359. J. T. Doyle, Cupertino	Oct. 11	28.00	------	.46	----	------	------	------	----
1891—No. 1530. Paso Robles	Oct. 6	26.50	------	.34	----	------	------	------	----
1892—No. 1722. Paso Robles	Oct. 10	25.20	------	.41	----	------	------	------	----
1893—No. 1800. Amador station	Sept. 1	21.10	------	.87	----	------	------	------	----
1894—No. 2143. Amador station	Sept. 13	28.90	------	.35	----	------	------	------	----
No. 2238. Mission San José	Oct. 5	22.60	------	.49	----	------	------	------	----

RECORD OF TREATMENT.

No. 1105. *Rothgipfler*, from J. T. Doyle, Cupertino. Grapes arrived September 27, 1889, and were crushed the same day. The juice showed 28.2% of solid contents by spindle. The condition of the grapes was rather good, but they had commenced to dry up a little. They corresponded to Pulliat's description, but the bunches were somewhat more elongated. Fermentation commenced September 28th at 72.5°, and reached its maximum September 29th at 82°. On the seventh day the wine was dry and had fallen to the cellar temperature (72°). From 46.5 lbs. crushed were obtained 3.87 gals., corresponding to 167 gals. per ton; pomace, 30.6%; stems, 3.8%.

At six weeks from crushing the wine was clear, the color light-green, bouquet pleasant, but a little woody; flavor fruity, but tasting slightly of the wood; general quality good and advanced. At two months it was racked and taken to the cellar. At fifteen weeks the wine was in good order and of agreeable flavor and bouquet, but still had the woody taste; lees sound. Two months later it was racked into a one-gallon keg, and after six weeks the lees were found to be sound. At nine months from crushing the condition of the wine was bright, the bouquet and flavor both full and, but for a taste of cask, very agreeable; well developed, with good alcohol and body; general quality good.

No. 1359. *Rothgipfler*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 13, 1890, in good condition. The bunches were small, cylindrical, close, on short and slender peduncles; the berries small, regular, somewhat oval, on short and slender pedicels; the skin thick, tough, yellowish-green, much spotted; the flesh firm and sweet. The must showed 28.0% of solid contents by spindle.

No. 1530. *Rothgipfler*, from Paso Robles station. A sample for must analysis arrived October 8, 1891, in good condition. The bunches were small and compact, with round-ovoid berries. The grapes were mature, and the must showed 26.5% of solid contents by spindle.

No. 1722. *Rothgipfler*, from Paso Robles station. A sample for must analysis arrived October 13, 1892, in good condition. The must showed 25.2% of solid contents by spindle.

No. 1800. *Rothgipfler*, from Amador station. A sample for must analysis arrived September 4, 1893, in good condition, but not quite mature. The bunches were of medium size, compact, with small berries. The must showed 21.1% of solid contents by spindle.

PEVERELLA.

Synonym: Pfeffertraube.

Description.—Vine very vigorous; leaves of medium size, not very deeply lobed, smooth above, loose-woolly below; bunches large, conico-cylindrical, compact, on thick peduncles; berries of medium size, nearly round, juicy, tough-skinned, of greenish color. The vines do well in moist soils, but only in warm localities. The grapes ripen late, but in suitable localities attain a high percentage of sugar with good acid.

The Peverella is cultivated principally in southern Tyrol and Venetia. It is said to give there a good, alcoholic wine of fair aroma. At the Experiment Stations it has shown itself a vigorous grower and good bearer. The must has always had good to high acid, but occasionally fails to develop enough sugar in the cooler localities. The wine made has been neutral in character, smooth and agreeable, but evidently needs blending with a variety of higher quality.

ANALYSES OF MUSTS AND WINES.

PEVERELLA.	Date of Picking	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six to Eight Months	Body
						By Weight	By Volume		
1889—No. 1190. J. T. Doyle, Cupertino	Oct. 17	20.40	------	.50	.22	7.78	9.73	.36	1.55
1890—No. 1406. J. T. Doyle, Cupertino	Oct. 20	23.05	------	.87	.27	9.70	12.09	.57	2.32
No. 1426. J. Gallegos, Mission San José	Oct. 28	29.10	------	.92	----	------	------	------	----
1891—No. 1463. Fresno	Aug. 28	23.92	22.67	.74	.43	9.41	11.73	.48	2.25
No. 1602. Cupertino	Oct. 23	20.85	20.24	.67	.30	8.70	10.83	.52	2.05
1892—No. 1743. Paso Robles	Oct. 11	24.35	------	.41	----	------	------	------	----
No. 1782. Mission San José	Oct. 18	23.15	------	.80	---	------	------	------	----
1893—No. 1836. Amador station	Sept. 5	22.60	------	.89	----	------	------	------	----
No. 1941. Tulare	Oct. 10	24.40	------	.50	----	------	------	------	----
No. 2015. Mission San José	Oct. 25	23.10	21.22	.94	.23	9.70	12.09	.67	2.80
1894—No. 2191. Amador station	Sept. 25	26.90	------	.51	----	------	------	------	----
No. 2300. Mission San José	Oct. 12	19.75	------	.67	----	------	------	------	----
No. 2330. Tulare	Oct. 15	26.90	------	.38	----	------	------	------	----

RECORD OF TREATMENT.

No. 1190. *Peverella*, from J. T. Doyle, Cupertino. Grapes arrived October 18, 1889, in good condition, and were crushed the same day. The bunches were medium in size, cylindrical, winged, rather loose; grapes were small, round, or sometimes very slightly longer than their width; skin not thick, but rather tough; color from green to golden, with a light bloom; flesh soft and juicy; flavor acid; stems thick; pedicels long and slender; maturity complete. The juice showed 20.40% of solid contents by spindle. Fermentation of 113½ lbs. crushed began on October 19th at a temperature of 68° (room, 72°), and reached its maximum the following day at a temperature of 76°, and remained at the same temperature during twenty-four hours, when the murk was drawn off. The yield from the above amount was $9\frac{3}{16}$ gals., corresponding to 161.89 gals. per ton; pomace, 19.6%, and stems, 5.06%.

At one month the wine was nearly clear, and was racked. At three months it was still nearly clear; bouquet and flavor not marked; taste rather flat; acid adequate; quality raw, but may mature-out well. At six months the lees were sound; a not quite bright wine, but tastes sound; racked again. At eight months the wine was bright, very light amber in color, with a peculiar, smoky bouquet and flavor; taste clean; body and acid rather low. Quality thin, but not bad.

No. 1406. *Peverella*, from J. T. Doyle, Cupertino. Received October 23, 1890, in good condition; fine, large, well-filled bunches of under-average sized, round grapes, mature. The must showed 23.05% of solid contents by spindle. The fermentation lasted eight days, and reached its maximum temperature of 84° on the third day.

At one month the wine showed good quality, was nearly clear, and had a good flavor, some aroma, medium acid, and good body. At two months it was racked for the second time, and a month later the lees showed a few lactic rods, so the wine was pasteurized. The taste had not become affected by the lactic ferment. At seven months the wine was bright and much improved, of full, delicate bouquet and flavor. It was racked twice after this, but the quality deteriorated. Some of it was bottled at eighteen and some at twenty-six months, but it did not keep well in bottle.

No. 1426. *Peverella*, from Mission San José. A sample for must analysis arrived October 31, 1890, in poor condition, overripe. The must showed 29.1% of solid contents by spindle.

No. 1463. *Peverella*, from Margherita Vineyard, Fresno. Received August 31, 1891, in good condition, but not quite mature. The must showed 23.92% of solid contents by spindle. The fermentation was slow and cool. The maximum temperature of 75° was reached on the second day, and the murk remained at this temperature for two days, after which it continued fermenting slowly at about the temperature of the room (71° to 74°) for a month.

At the end of six weeks the wine was nearly clear and quite dry. At ten weeks it was bright, and showed good flavor and aroma. At the end of five months it had been racked twice, and was bright and clean-tasting. It remained sound and became smoother, but developed little bouquet. It was racked four times during the first year. At sixteen months it was in good condition, very smooth and agreeable, and quite mature. A few days after this it was bottled.

No. 1602. *Peverella*, from J. T. Doyle, Cupertino. Received October 24, 1891, in good condition. The must showed 20.85% of solid contents by spindle. The fermentation was slow and cool, lasting ten days. Five weeks from crushing the wine was racked for the second time, and blended with No. 1601, White Vernaccia.

No. 1743. *Peverella*, from Paso Robles station. A sample for must analysis arrived October 13, 1892, in good condition. The must showed 24.35% of solid contents by spindle.

No. 1782. *Peverella*, from Mission San José. A sample for must analysis was received October 21, 1892, in poor condition. The must showed 23.15% of solid contents by spindle.

No. 1836. *Peverella*, from Amador station. A sample for must analysis arrived September 8, 1893, in good condition. The bunches were of good size, long-cylindrical, fairly compact; the berries small, not mature. The must showed 22.6% of solid contents by spindle.

No. 1941. *Peverella*, from Tulare station. A sample for must analysis was received October 13, 1893, in good condition, but a little sunburned. The bunches were small, compact, irregularly conico-cylindrical; the berries over medium in size, with thick, tough skin, and without flavor. The must showed 24.4% of solid contents by spindle.

No. 2015. *Peverella*, from Mission San José. Received October 25, 1893, in good condition. The bunches were over medium in size, close, conico-cylindrical, slightly shouldered or with one small wing; the berries of medium size, nearly round, juicy, thick-skinned, not quite mature. The must showed 23.1% of solid contents by spindle. It was fermented with No. 2014, White Vernaccia.

VERNACCIA BIANCA.

Synonyms: Vernazza; Weiss-Vernatsch.

Description.—Vine vigorous; leaves of medium size, dark green, smooth above, a little woolly below, deeply lobed, and with acute teeth; bunches of medium size, conico-cylindrical, somewhat compact, generally without shoulders; berries small, firm, juicy, and nearly round, greenish-white; seeds free from the pulp, sharp, and incurved.

The name Vernaccia is given to several distinct grapes in Italy, but the one described above is that which forms the bulk of the white-wine vineyards of northern and southern Tyrol. It is also grown in Lombardy and the province of Pavia. It bears well with moderately short-pruning, and is especially adapted to low and damp situations, on account of its tardiness in coming out in the spring. It ripens its grapes a little earlier than the Peverella, and attains rather a higher percentage of sugar. It is noted for retaining a good amount of acid, even with high sugar-contents, but at the Tulare station it has failed to confirm its reputation in this respect.

In suitable locations it gives a full-bodied, alcoholic wine, of good quality, but with less aroma than the best Rhine-wine varieties. It will doubtless prove an excellent variety in warm localities, for damp valley lands subject to early frosts, in association with the Peverella, with which it makes a very good blend.

ANALYSES OF MUSTS AND WINES.

VERNACCIA BIANCA.	Date of Picking	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six to Eight Months	Body
						By Weight	By Volume		
1889—No. 1091. J. Gallegos, Mission San José	Sept. 17	24.36	24.64	.66	.37	------	------	------	------
No. 1148. J. T. Doyle, Cupertino	Oct. 8	23.15	21.80	.55	.31	9.70	12.09	.40	2.45
1890—No. 1236. Margherita Vineyard, Fresno	Aug. 22	23.40	23.13	.53	.33	------	------	------	------
No. 1400. J. T. Doyle, Cupertino	Oct. 18	25.90	------	.68	----	------	------	------	------
No. 1422. J. Gallegos, Mission San José	Oct. 28	28.60	------	.66	----	------	------	------	------
1891—No. 1549. Paso Robles	Oct. 6	22.60	21.80	.32	----	------	------	------	------
No. 1601. Cupertino	Oct. 26	23.70	23.61	.81	.33	------	------	------	------
1892—No. 1723. Paso Robles	Oct. 10	25.45	------	.36	----	------	------	------	------
No. 1781. Mission San José	Oct. 18	24.80	------	.65	----	9.92	12.36	.73	2.70
1893—No. 2014. Mission San José	Oct. 24	24.80	23.80	.84	.32	------	------	------	------
No. 2104. Cupertino	Nov. 4	24.80	------	1.07	----	------	------	------	------
1894—No. 2188. Amador station	Sept. 23	24.70	------	.38	----	------	------	------	------
No. 2305. Mission San José	Oct. 10	22.20	------	.51	----	------	------	------	------
No. 2328. Tulare	Oct. 13	23.30	------	.32	----	------	------	------	------

RECORD OF TREATMENT.

No. 1091. *Vernaccia bianca.* From J. Gallegos, Mission San José. The grapes arrived September 19, 1889, consisting of only a few bunches for must analysis. Their maturity was irregular. They corresponded to Pulliat's description, except that none of the bunches had wings. The juice showed 24.36% of solid contents by spindle.

No. 1148. *Vernaccia bianca*, from J. T. Doyle, Cupertino. The grapes arrived October 9, 1889, and were crushed the same day. The bunches were irregular, some cylindrical, some conical and branched, not compact. The grapes were slightly oval, medium size; skin green, thick, rather tough; flesh very soft and juicy; flavor quite spoilt by overripeness and rain. The grapes had commenced to rot. The juice showed 23.15% of solid contents by spindle. Fermentation of 118½ lbs. crushed started on the afternoon of October 10th at 69° (room, 72°), and reached its maximum of 77.5° on October 12th (room, 72°), gradually falling to 70° on October 17th, when the wine was dry, and was put in keg.

The yield from the above amount was 7⅞ gals. of wine, corresponding to 131.2 gals. per ton; pomace, 28.5%, and stems, 3.8%.

Twenty-one days after crushing the wine was clear, the bouquet developing, the flavor agreeable and smooth, the taste clean, the acid normal, and the alcoholic strength high; the general quality was good and well developed for its age. In five days it was racked and taken to the cellar. At eighty days the wine was still clear, with a delicate and pleasing bouquet and flavor, much developed since last tasting; lees sound. At six months it was racked again. Eight months after crushing, it was bright, bouquet perfumed, taste rather thin, but is otherwise of very good quality; acid and alcoholic strength adequate.

No. 1236. *Vernaccia bianca*, from Fresno. A sample for must analysis arrived August 25, 1890, in fair condition, and quite mature. The must showed 23.4% of solid contents by spindle and 0.53% of acid.

No. 1400. *Vernaccia bianca*, from Cupertino. A sample for must analysis was received October 21, 1890, in fair condition, and somewhat overripe. The must showed 25.9% of solid contents by spindle and 0.68% of acid.

No. 1422. *Vernaccia bianca*, from Mission San José. A sample for must analysis was received October 31, 1890. The must showed 28.6% of solid contents by spindle and 0.66% of acid.

No. 1549. *Vernaccia bianca*, from Paso Robles station. A sample for must analysis was received October 8, 1891, in good condition, and mature. The bunches were small, but well filled. The must showed 22.6% of solid contents by spindle and 0.32% of acid.

No. 1601. *Vernaccia bianca*, from Cupertino. Received October 24, 1891, in good condition. The must showed 23.7% of solid contents by spindle and 0.81% of acid. Only 30 lbs. of grapes were crushed, and the fermentation lasted eleven days, the highest temperature reached being 74°.

The wine was racked eleven days after crushing, and at one month was clear, with good but neutral flavor, and good acid. At six weeks it was racked again and blended with No. 1602, Peverella, in the proportion of one third Vernaccia to two thirds Peverella. At three months the wine was very clear, clean-tasting, with full acid and neutral flavor, and was racked again. The lees were examined microscopically at three and at four months, and found to be quite sound. At five months it was racked again, and was bright and fresh-tasting. At seven and eight months it showed little change, and was racked again. At fifteen months the wine was bright, smooth, and mature, with good flavor and a little bouquet; it was then bottled. After two years in bottle the wine had acquired a slight Sherry character; it was very smooth and agreeable, but without marked flavor or bouquet.

No. 1723. *Vernaccia bianca*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 25.45% of solid contents by spindle and 0.36% of acid.

No. 1781. *Vernaccia bianca*, from Mission San José. Received October 21, 1892, in fair condition. The must showed 24.8% of solid contents by spindle and 0.65% of acid. The grapes were fermented with No. 1782, Peverella, in the proportion of one fifth Vernaccia to four fifths Peverella. The highest temperature reached during fermentation was 77°.

In one month the wine was quite clear, and was racked. At three months it was bright, of full, rich flavor, some bouquet, high acid, and generally of good quality. Two months later it was in good condition, and was racked again. Tastings at eight, ten, and fourteen months showed steady maturing and gradual development of bouquet. At fifteen months the wine was still very good, but had become a little *éventé*. As the wine would evidently not improve further in so small a keg (five gallons), it was bottled. Two years after bottling the wine was very good; it was full-flavored, full-bodied, and with good acid. The bouquet was rather faint, but of good quality. Altogether, it was a very successful blend.

No. 2014. *Vernaccia bianca*, from Mission San José. Received October 26, 1893, in good condition. The bunches were small, conico-cylindrical, somewhat compact, not shouldered; berries small, round, juicy, with full acid. The seeds are quite characteristic, being quite free from the pulp, sharp, and incurved. The must showed 24.8% of solid contents by spindle and 0.84% of acid. The grapes were fermented with No. 2015, Peverella, in the proportion of nine sixteenths Vernaccia to seven sixteenths Peverella. The fermentation lasted nine days, reaching the maximum temperature of 76° on the third day. A parallel fermentation was made of the same quantity of each variety of grapes, with the addition of some German yeast. As no precautions were taken to exclude the ordinary yeast, the result was perfectly negative. There was apparently no difference in the course of fermentation or in the resulting wine of the two experiments, except that the must to which the yeast was added became dry a few days before the other, a result that is easily understood without predicating any peculiar properties of the German yeast.

No. 2014 (ordinary ferment). Two weeks after the first racking the wine was clear, but still a little sweet; it was racked again and taken to the cellar. At three months it was bright, clean-tasting, and with good flavor and aroma. At four months the wine had been racked three times, and was in very good order; a very agreeable wine, but without marked character. At eight months the wine was bright, clean-tasting, highly acid, but rather too neutral in flavor. The wine had no lees. At nineteen months it was mature, and was put in bottle. Six months after bottling the wine was perfectly bright, and had deposited no sediment. It was a smooth, good wine, much improved, and had developed a little bouquet. It tasted more mature than No. 2014*a*; in fact, a little flat.

No. 2014*a* (German ferment). Two weeks after the first racking the wine was clear and dry. At one month it was taken to the cellar. At three months it was bright, clean-tasting, with some aroma, and rather fresher-tasting than No. 2014. Several tastings after this showed little difference between the two samples, except that the wine which had been fermented with the ordinary ferments seemed to develop a little quicker. At fifteen months it was well developed, had good flavor, and had more bouquet than No. 2014. At nineteen months it tasted mature, and was bottled. Six months after bottling it was perfectly bright, and had developed no sediment. It was of distinctly higher bouquet than No. 2014, fresher-tasting, and generally better. The difference of character, which at first was scarcely noticeable, was at this time marked. The use of the German ferment seemed to have caused a slower maturity, but the development of higher quality.

FURMINT.

Synonyms: Gelber Mosler; Formint; Tokayer.

Description.—Vine vigorous, with thick, upright canes; leaves large thick, three-lobed, hairy below, teeth large and blunt, petiole thick, reddish, and somewhat hairy, young leaves white-woolly; bunches large, loose, long conico-cylindrical; berries of medium size, oval, on long, slender pedicels; flesh crisp, not juicy; skin from green to brown-yellow, and marked with brown dots and blotches.

This is the most valued and one of the most widely grown vines of Hungary and Austria. It is not found elsewhere, except to a limited extent in the south of France, where it was introduced from Hungary; and the name of Mosler is said not to be derived from the Moselle River, for it is not known in that district. It is valued on account of the high amount of sugar which it attains, and is used, especially in Styria, for mixing with thin, neutral grapes, such as the Heunish, to increase their alcoholic contents and quality. It is famous chiefly, outside of Austria, for making the celebrated sweet wines of Tokay. The vine is said to be a good bearer in its native country, but at the Experiment Stations it has produced very little. It has borne well and produced some good wine at Fresno. It ripens rather early, and requires medium-long pruning, and a warm location.

RECORD OF TREATMENT.

No. 2189. *Furmint*, from Amador station. A sample for must analysis was received September 24, 1894, in good condition. The bunches were large, loose, and badly coulured; the berries from large to small, ellipsoidal, on long, slender pedicels, which were not swollen at the junction with the berries; flesh crisp, not juicy; skin thin, from green to brown-yellow, conspicuously marked with brown spots and blotches; flavor not marked, but sweet. The must showed 23.15% of solid contents by spindle and 0.38% of acid.

ZIERFAHNDLER.

Description.—Vine strong and vigorous, with thick, dark-brown canes; leaves round, of medium size, five-lobed, with shallow sinuses, lobes overlapping, glabrous above, little downy below, teeth short and blunt; bunches small, cylindrical, with small shoulders, compact; berries small, round, soft, juicy, thin-skinned, sweet, but without special flavor.

The above description of this grape as grown in California does not agree altogether with that given of the Rother Zierfahndler of Austria by Goethe. Our grape has smaller bunches, more deeply colored berries, and ripens earlier. This variety is considered by some authors to be simply a pink-fruited form of the Franken Riesling, with which it has great similarity in leaf characters. It is a strong grower, and bears fairly well; its wine has rather more character than that of the Franken Riesling, but is far from possessing the strong aroma of the Traminer. In the warmer parts of California it fails to color well or to develop its aroma. It is rather later than the Ruländer, but if left long enough on the vines it attains almost an equal amount of sugar, with rather higher acid. It bears, in the districts suited to it (that is, the cooler coast counties), with short-pruning. The Zierfahndler is said in Austria to attain the highest percentage of sugar of any grape and to make an extremely fiery, alcoholic wine, which retains part of the sugar unfermented, and is very much appreciated as a dessert wine.

ANALYSES OF MUSTS AND WINES.

ZIERFAHNDLER.	Date of Picking	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six to Eight Months	Body
						By Weight	By Volume		
1889—No. 1133. J. T. Doyle, Cupertino	Oct. 2	23.30	23.13	.47	.33	9.05	11.27	.44	2.35
1890—No. 1314. J. Gallegos, Mission San José	Oct. 7	26.50	------	.41	.40	10.81	13.27	.50	----
No. 1323. J. T. Doyle, Cupertino	Oct. 11	24.35	------	.75	----	------	------	------	----
1891—No. 1577. Mission San José	Oct. 13	27.35	-----	.33	----	11.32	13.75	.32	2.70
1892—No. 1760. Paso Robles	Oct. 11	18.15	------	.46	----	------	------	------	----
1893—No. 2090. J. T. Doyle, Cupertino	Nov. 5	24.80	------	.60	----	------	-----	------	----
1894—No. 2279. Amador station	Oct. 4	22.60	------	.42	----	------	------	------	----
No. 2280. Mission San José	Oct. 4	20.00	------	.53	----	------	------	------	----

RECORD OF TREATMENT.

No. 1133. *Zierfahndler*, from J. T. Doyle, Cupertino. Received October 3, 1889, in good condition, and crushed the same day. The grapes were ripe, the bunches over average in size, some loose from coulure, but in general compact. The berries on loose bunches were rather large, quite round, and rose-colored; those on compact bunches were smaller and green, except where exposed to the sun; the skin was soft, but rather thick; the flesh sweet and juicy; the stems thick and the pedicels long. The temperature of the grapes at crushing was 71°, and the maximum reached was 77°, on the second day.

At two months the wine was nearly bright and had a slight schiller color, was of fair quality, but tasted of the wood; it was racked and taken to the cellar. Two months later it was bright and had lost some of its pinkish tinge, had developed some bouquet, and was generally much improved. An examination of the lees showed no unsound germs. At six months the wine was racked for the third time, and at seven months the lees were examined and found to contain some unsound germs. The wine was of good quality, well-flavored and full-bodied, but was somewhat affected by the secondary ferments. It was pasteurized, but did not improve; it remained flat and developed no bouquet.

No. 1314. *Zierfahndler*, from Mission San José. Received October 10, 1890, in somewhat bruised condition, but not moldy. The must showed 26.5% of solid contents by spindle. The fermentation was cool, and lasted six days.

At one month the wine had been racked twice, was clear, smooth, full-bodied, and with marked aroma. At three months the lees showed much lactic ferment, and the taste was affected; it was pasteurized, but remained cloudy for some time. At fourteen months it was clear and much improved, but still showed some lactic taste. At seventeen months it was racked. At twenty-seven months the bottled wine was bright, very smooth and soft, sound, but a little flat.

No. 1323. *Zierfahndler*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 13, 1890, in fair condition. The must showed 24.35% of solid contents by spindle.

No. 1577. *Zierfahndler*, from Mission San José. Received October 16, 1891, in fair condition, and mature. The must showed 27.35% of solid contents by spindle. The must attained its maximum temperature of 80° on the third day, and fermented for five days, when it was nearly dry.

The wine was a little slow in clearing, and at one month the lees showed a little lactic ferment. At six weeks the wine was pasteurized. At five months the wine was good, but a little flat, full-bodied, low in acid, and with a remarkably high aroma. At seven months it had improved, and tasted quite sound. At ten months it was racked for the fourth time. At fifteen months it still retained its high flavor and full aroma, and had become smoother and cleaner-tasting. As it was in a small keg, it was bottled.

No. 1760. *Zierfahndler*, from Paso Robles station. A sample for must analysis arrived October 13, 1892, in good condition. The must showed 18.15% of solid contents by spindle.

No. 2090. *Zierfahndler*, from J. T. Doyle, Cupertino. A sample for must analysis was received November 6, 1893, in good condition; the bunches were under medium size, long-conical, and compact; the berries small, soft, juicy, very sweet, and mature. The must showed 24.8% of solid contents by spindle.

ROTHER STEINSCHILLER.

Synonyms: Rosentraube; Rother Verschetzer.

Description.—Vine very vigorous, with thick, short-jointed canes; leaves large, flat, little lobed, sharply toothed, the under side white-woolly; bunches of medium size, short, irregular, much branched, compact; berries under medium size, round, firm, from green to pink, according to position on the bunch, and becoming brownish with advanced maturity, skin very astringent, flavor neutral. The grapes ripen rather late and resist the action of the weather very well.

The Rother Steinschiller is cultivated extensively in parts of the Banat in southern Hungary, but is little known elsewhere. In cooler climates it will only ripen in the warmest exposure. In the Banat it bears large crops every year, with short-pruning. The Steinschiller vineyards produce large quantities of a mild, cheap wine, which is considered indispensable by the Austrian and Hungarian wine-merchants for blending purposes.

The Steinschiller has given results in California very similar to those reported from its native home. It bears well at all the stations where tried, and produces a neutral wine, low in alcohol, with medium acid, agreeable to drink, but without special flavor, and requiring the addition of some grape of more marked character. It is an extremely healthy vine, and is one of the best resisters of the *oidium* mildew.

Analyses of Musts and Wines.

STEINSCHILLER.	Date of Picking	MUST.				WINE.			
						Alcohol.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	By Weight	By Volume	Total Acid as Tartaric, at Six to Eight Months	Body
1889—No. 1174. J. Gallegos, Mission San José	Oct. 15	20.50	20.61	.33	.21	8.27	10.36	.57	2.32
No. 1201. J. T. Doyle, Cupertino	Oct. 23	19.30	18.89	.24	.23	7.85	9.82	.33	1.66
1890—No. 1415. J. T. Doyle, Cupertino	Oct. 27	20.60	------	.50	.29	8.91	11.09	.45	2.14
No. 1424. J. Gallegos, Mission San José	Oct. 28	23.70	------	.53	----	------	------	------	------
1892—No. 1783. Mission San José	Oct. 18	17.35	------	.73	----	------	8.46	.48	2.10
1893—No. 1996. Mission San José	Sept. 30	21.70	------	.73	----	------	------	------	------
No. 2016. Mission San José	Oct. 26	21.50	20.46	.55	.30	8.91	11.18	.68	2.60
No. 2068. Paso Robles	Nov. 1	21.50	20.99	.43	.27	14.02*	17.92*	.41	3.90
No. 2103. Cupertino	Nov. 2	21.20	------	.50	----	-----	------	------	------

* Fortified.

Record of Treatment.

No. 1174. *Steinschiller*, from Mission San José. Received October 16, 1889, in good condition, and mature. The bunches were of average size, conico-cylindrical, sometimes shouldered or winged, close; berries under medium size, round, light red, with thick bloom, thick but tender skin, firm and juicy flesh, flavor agreeable and sweet, but not marked; peduncles thick and woody, pedicels of medium length, and slender.

Only enough grapes were received to make one gallon of wine. It was of golden color, medium acid, very agreeable flavor, and in general a very promising wine, but owing to the smallness of the sample, it soon became acetified. The wine was kept for five months, then pasteurized; it developed some bouquet, and at seventeen months showed good quality, but was injured because of the smallness of the sample.

No. 1201. *Steinschiller*, from Cupertino. Received October 24, 1889, in good condition. Bunches of medium to over medium size, conical, heavily shouldered, generally compact; berries small, round, dark-rose colored, with thick but tender skin, rather soft and juicy flesh, agreeably flavored, but rough; maturity complete. The grapes had been exposed on the vines to many days of heavy rains, but were uninjured. The must showed 19.3% of solid contents by spindle and 0.24% of acid. The 70.5 lbs. of grapes received were made up into 5.5 gals. of white wine.

The wine was bright six weeks after pressing, of very light color, with little bouquet, and peculiar but not very agreeable flavor, low-bodied, and rather flat. It was racked and taken to the cellar, and six weeks later it was bright, improved in bouquet and flavor, but still rather insipid and watery-tasting. The wine was completely neutral in character, not disagreeable, but without any distinctive qualities. At six months the lees showed some bitter ferments, so the wine was pasteurized. One month later the wine was bright and tasted nearly mature, but was still insipid. After this it remained sound, and improved a little. At seventeen months it was bottled. It remained bright and sound in bottle, and at two years and a half it had improved and was of fair quality. Tasted a year later it had changed very little.

No. 1415. *Steinschiller*, from Cupertino. Received October 30, 1890, in good condition, and mature. The must showed 20.6% of solid contents by spindle and 0.50% of acid. The grapes were crushed on the day of arrival, 227.5 lbs. in all making 17.63 gals. of wine. The temperature of the must at crushing was 66.5°, and the maximum reached was 77°, on the third day.

The wine was dry on the eleventh day, when it was racked off the lees. At one month the wine was still cloudy, but the lees were sound. At two months the wine was bright, had light bouquet, full and pleasing but not marked flavor, sufficient acid, body, and alcohol; in general, of good quality. At four and at six months examination of the lees showed them to be sound. At six months the wine was bright, clean-tasting, and well developed. At fourteen months it showed good bouquet, full, rich flavor, was quite mature, sound, and clean-tasting. Two months later it was racked and part put in bottle. Six months later the remainder was bottled. At three years the bottled wine was in good order and of good quality, but without marked or special character. That first bottled had the best aroma, but tasted a little raw.

No. 1424. *Steinschiller*, from Mission San José. A sample for must analysis was received October 31, 1890, in good condition; well colored and mature. The must showed 23.7% of solid contents by spindle and 0.53% of acid.

No. 1783. *Steinschiller*, from Mission San José. A sample for must analysis was received October 21, 1892, in poor condition. The must showed 17.35% of solid contents by spindle and 0.73% of acid. The grapes were fermented with No. 1784, Grüner Velteliner, in the proportion of 124 lbs. of the former to 144.5 lbs. of the latter. The temperature of the must at pressing was 66°, and the maximum reached was 78°, on the third day.

In one month the wine was quite clear, and was racked and taken to the cellar. At three months the wine was bright, smooth, and pleasing, without much flavor or bouquet, but sound and good. Two months later it had developed a good bouquet, and was racked for the second time. After this it remained in good order, and at fourteen months was very good and nearly mature. At seventeen months it was bottled.

No. 1996. *Steinschiller*, from Mission San José. A sample for must analysis was received October 1, 1893, in good condition, but not quite mature. The bunches were large, conical, heavily shouldered and winged, close; the berries under medium in size, round, and firm. The must showed 21.7% of solid contents by spindle and 0.73% of acid.

No. 2016. *Steinschiller*, from Mission San José. Received October 26, 1893, in good condition, but not quite mature. The bunches were over medium in size, branching, irregular, well filled, and with very heavy peduncles; berries from small to medium, round, dull red, with very astringent skin and small seeds. The 139.5 lbs. of grapes were made up into 12 gals. of white wine. The temperature of the must at pressing was 69°, and the maximum reached was 75°, on the third day.

In one month the wine was clear, and was racked and taken to the cellar. At three months it was bright, with a little bouquet, not much flavor, full acid—a clean, neutral wine. Two weeks later it was racked for the second time, and at six months it was a very robust, clean-tasting wine, without much character, but pleasing. After this it remained in good order, a good neutral wine, but did not improve much. At fifteen months the lees showed *S. pastorianus*, and the wine was bright, but lacking in character.

No. 2068. *Steinschiller*, from Paso Robles station. Received November 3, 1893, in good condition, but not quite mature. The bunches were small to medium, well filled, irregularly conical, sometimes branching; berries round, under medium in size, green or pink, fresh-tasting, with astringent skin and without much flavor. The must showed 21.5% of solid contents by spindle and 0.43% of acid. The grapes were crushed on the day received, and 108 lbs. yielded 8.13 gals. of wine. The temperature of the must at pressing was 64°, and the maximum reached was 76°, on the fourth day. The must fermented very slowly, and on the ninth day, when still sweet, it was fortified for sweet wine.

A month after fortifying it was not quite bright and tasted a little too sweet. A week later it was racked and put in the hot chamber, at a temperature of 95°, where it was kept for three months. At eight months it was racked again. At twenty months it was perfectly bright, of a beautiful golden color, without much aroma, but with clean taste and good promise.

No. 2103. *Steinschiller*, from Cupertino. A sample for must analysis was received November 3, 1893, in good condition. The bunches were of medium size or under, conical, shouldered or with one or two wings nearly as large as the main bunch, compact; berries medium size, round, of a purplish-brown color, juicy, and with a very astringent skin. The must showed 21.20% of solid contents by spindle and 0.43% of acid.

SLANKAMENKA.

Synonym: Mayarka.

Description.—Vine very vigorous and fruitful, with thick, short-jointed canes; leaves shining, yellowish-green, five-lobed, and a little woolly below; bunches large, conical, and well filled; berries of medium size, oval, yellowish-white, becoming slightly tinged with red where exposed to the sun, pulpy, thick-skinned, and not easily injured by the weather.

This variety is, next to the Steinschiller, the most widely cultivated in southern Hungary for the production of ordinary, light white wines. It bears heavily with short-pruning, and is very free from injury by the ordinary diseases of the vine. It has borne fair crops at the Experiment Stations, but has not exhibited the great productiveness which is claimed for it in Hungary. It has, on the contrary, attained a higher percentage of sugar here than in Europe, and gives a very agreeable wine.

Analyses of Musts and Wines.

SLANKAMENKA.	Date of Picking	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Body
1889—No. 1197. J. T. Doyle, Cupertino	Oct. 23	18.80	17.71	.39	.41	6.42	8.07	.46	1.63
1890—No. 1410. J. T. Doyle, Cupertino	Oct. 27	18.20	------	.62	----	------	------	------	------
1893—No. 1988. J. Gallegos, Mission San José	Oct. 18	25.95	25.19	.54	.30	10.16	12.64	.50	2.60
No. 2092. J. T. Doyle, Cupertino	Nov. 5	23.30	------	.59	----	------	------	------	------
1894—No. 2228. Mission San José	Oct. 5	22.00	------	.55	----	------	------	------	------

Record of Treatment.

No. 1197. *Slankamenka*, from J. T. Doyle, Cupertino. Received October 24, 1889, in poor condition. In spite of their European reputation for good keeping qualities, the grapes were injured by the rain. The must showed 18.8% of solid contents by spindle and 0.39% of acid. The bunches were of average size, conical, shouldered, and compact; the berries of medium size, slightly oval, thick but not tough skin, with firm but juicy flesh, of yellowish color, much spotted, and of neutral flavor. The peduncles and pedicels were short. The temperature of the grapes at crushing was 68°, and the maximum reached was 75°, on the third day.

At seven weeks the wine was clear, very light-colored, smooth, and with nutty flavor, but without aroma; it was of rather low acid and good quality. At this time it was racked for the second time and taken to the cellar. At ten weeks the lees showed *Mycoderma vini*, and a month later the wine showed the effect of secondary ferments, and was not clear, so it was pasteurized. A month later it was clear, but much deteriorated in flavor by the presence of volatile acids. After this it rapidly deteriorated.

No. 1410. *Slankamenka,* from J. T. Doyle, Cupertino. A sample for must analysis was received October 30, 1890, in good condition; nearly ripe, but not sweet. The must showed 18.2% of solid contents by spindle and 0.62% of acid.

No. 1988. *Slankamenka,* from Mission San José. Received October 19, 1893, in good condition. The bunches were of medium size, irregularly conico-cylindrical, with or without small wings, well filled but not compact, on very thick, herbaceous peduncles; berries small, ovoid, crisp, juicy, on slender pedicels. The grapes were mature and very fresh-tasting, but without special flavor. The must showed 25.95% of solid contents by spindle and 0.54% of acid. The temperature of the grapes at crushing was 63°, and the maximum reached was 78°, on the third day. The wine was nearly dry on the eighth day, when it was drawn off.

At one month the wine was not clear and was still fermenting a little. Two weeks later, when it was racked for the second time and taken to the cellar, it was still a little sweet. At four months it was racked for the third time; it was bright, of good flavor and aroma, very clean-tasting and fresh, but without marked character. At eight months it tasted very smooth and agreeable. At ten months it was nearly mature, was in good order, smooth, with agreeable acidity, and had developed some bouquet. A week later it was bottled.

No. 2092. *Slankamenka,* from J. T. Doyle, Cupertino. A sample for must analysis was received November 6, 1893, in good condition. The bunches were over medium in size, conical, heavily shouldered, well filled; the berries of medium size, slightly oval, crisp, thick-skinned, and astringent. The grapes were mature, and the must showed 23.3% of solid contents by spindle and 0.59% of acid.

BAKATOR.

Synonym: Bacador.

Description.—Vine vigorous; canes strong, somewhat erect, with large joints, the younger parts woolly; leaves large, deeply lobed, often with closed sinuses, short-toothed, glabrous above, more or less woolly below, petioles woolly; bunches large, spreading, irregular; berries of medium size, round, crisp, juicy, of neutral flavor and bright rose color. The down on the leaves varies much with locality. At Cupertino and Mission San José the leaves are white woolly below; at Tulare they are green below and much less woolly. The down on the young canes and leaf stalks seems constant. At Tulare the grapes do not color well.

The Bakator is cultivated principally at Arad, in Hungary, and in Transylvania. It requires a warm climate, and grows well even in very poor soils. It bears well with half-long pruning, but when short-pruned coulures very badly. The grapes are very agreeable to eat, and ornamental for the table when well colored. They are, however, too delicate for shipping, and, as they are neither very early nor very late, the planting of more than a few vines for home use cannot be recommended. In Hungary, the wine of the Bakator is said to be smooth, of low acidity, and very alcoholic. In California, so far, it has made a neutral, clean-tasting wine, but not of quality sufficient to encourage its propagation, especially in view of its extreme liability to coulure.

Analyses of Musts and Wines.

BAKATOR.	Date of Picking	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six Months	Body
						By Weight	By Volume		
1890—No. 1319. Cupertino	Oct. 11	24.05	------	.71	----	------	------	------	----
1891—No. 1537. Paso Robles	Oct. 6	22.60	------	.48	----	------	------	------	----
1892—No. 1728. Paso Robles	Oct. 10	24,80	------	.47	----	------	------	------	----
1893—No. 1841. Amador station	Sept. 5	18.80	------	.66	----	------	------	------	----
No. 2011. Mission San José	Oct. 26	20.60	19.90	.80	.25	------	------	------	----
No. 2080. Paso Robles	Nov. 2	24.80	23.61	.44	.32	10.01	12.54	.40	2.10
No. 2089. Cupertino	Nov. 5	21.50	------	.83	----	------	------	------	----
1894—No. 2179. Amador station	Sept. 24	24.80	------	.49	----	------	------	------	----
No. 2202. Tulare	Sept. 27	25.00	------	.41	----	------	------	------	----
No. 2232. Mission San José	Oct. 5	20.30	------	.62	----	------	------	------	----

Record of Treatment.

No. 1319. *Bakator*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 13, 1890, in good condition. The must showed 24.05% of solid contents by spindle.

No. 1537. *Bakator*, from Paso Robles station. A sample for must analysis arrived October 8, 1891, in good condition. The bunches were of medium size, rather loose; the berries of medium size and well colored. The grapes were mature, and the must showed 22.6% of solid contents by spindle.

No. 1728. *Bakator*, from Paso Robles station. A sample for must analysis arrived October 13, 1892, in good condition. The must showed 24.8% of solid contents by spindle.

No. 1841. *Bakator*, from Amador station. A sample for must analysis arrived September 8, 1893, in good condition, but not mature. The bunches were of medium size, the berries small and very unevenly colored. The must showed 18.8% of solid contents by spindle.

No. 2011. *Bakator*, from Mission San José. A sample for must analysis arrived October 26, 1893, in good condition. The bunches were large, irregularly branching, short, very loose, and much coulured; the berries under medium in size, crisp, with high, fresh-tasting acid; the peduncles of the bunches were very large. The must showed 20.6% of solid contents by spindle.

No. 2080. *Bakator*, from Paso Robles station. Received November 4, 1893, in fair condition; a little moldy. The bunches were large, spreading, and loose; the berries of medium size, fairly well colored, and very sweet. The must showed 24.8% of solid contents by spindle. The fermentation was slow and prolonged, and reached its maximum temperature of 78° on the third day.

The wine was clear in three weeks from crushing. It was racked three times during the first three months. At six months it was clear and clean-tasting, with a little bouquet, but without much body or character.

No. 2089. *Bakator*, from J. T. Doyle, Cupertino. A sample for must analysis arrived November 6, 1893, in good condition. The bunches were over medium size, irregularly branching, much coulured; the berries of medium size, well colored, crisp, with full acid, but mature. The must showed 21.5% of solid contents by spindle.

GREEN HUNGARIAN.

Synonym: Long Green.

Description.—Vine a strong grower, with long, grayish-brown canes; leaves slightly lobed, acutely serrate, glabrous above and hairy below; bunches large, conical, with small shoulders, close; berries over medium in size, round, thin-skinned, juicy, covered with bloom.

This is one of the many grapes which have appeared in California without any record of their origin. It is very likely the "Weisse Heunisch," with which Goethe's description agrees very well. It is a heavy bearer in localities to which it is suited. At Tulare, with the system of pruning to which it has been subjected, it has produced very little, but has shown itself a very vigorous grower. It is a somewhat tasteless grape, but makes a good, light, neutral wine.

ANALYSES OF MUSTS AND WINES.

GREEN HUNGARIAN.	No. 1403. Cupertino.	No. 2004. Tulare.	No. 2094. Cupertino.
Date of picking	Oct. 21, 1890	Oct. 21, 1893	Nov. 4, 1893
Must.			
Solid contents by spindle	20.40	21.50	20.00
Acid as tartaric	.65	.48	.64
Ash	.31	.45	----------
Wine.			
Alcohol by weight	9.20	----------	----------
Alcohol by volume	11.45	----------	----------
Acid at five months	.57	----------	----------
Body	1.75	----------	----------

RECORD OF TREATMENT.

No. 1403. *Green Hungarian*, from Cupertino. Received October 23, 1890, in good condition. The bunches were of medium size, conical, shouldered, well filled, but not compressed, on thin stems; berries round, spotted, with thin but tough skin, and light bloom; flesh soft, juicy, and with neutral flavor. The must showed 20.4% of solid contents by spindle and 0.65% of acid. The temperature of the grapes at crushing was 67°, and the maximum reached was 81°, on the third day. On the fifth day the wine was dry. On the eighth day the wine was racked off the thick lees. At one month the wine was clear, and was racked for the second time. It was of neutral flavor and without aroma, clean-tasting, with full acid and low body. At three months the wine was racked again. and the lees were examined at two, three, five, and seven months, and found to be sound. At seven months the wine was bright, maturing well, not of high quality, but a good neutral wine. At fourteen months it was bright, pleasing, and nearly mature. Three months later it was racked again and part put in bottle. At twenty-three months it was all bottled. At three years and three months both samples were bright and sound; that bottled first was fresher-tasting and showed more flavor and aroma; they were, however, both good, clean-tasting wines, without marked character.

No. 2004. *Green Hungarian*, from Tulare station. A sample for must analysis was received October 23, 1893, in good condition. The bunches were of good size, conical, with small shoulders, close but not compacted; berries over medium in size, round, thin-skinned, juicy, sweet, and commencing to shrivel. The must showed 21.5% of solid contents by spindle and 0.48% of acid.

No. 2094. *Green Hungarian*, from Cupertino. A sample for must analysis was received November 6, 1893, in good condition. The bunches were large and with branches almost equaling the main bunch, close; the berries were small, round, soft, juicy, and without flavor. The must showed 20.0% of solid contents by spindle and 0.64% of acid.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF AUSTRIAN AND HUNGARIAN TYPE.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at Six to Eight Months	Body
	Wälschriesling.								
1158	Cupertino	1889	23.50	23.13	.36	.29	13.27	.36	1.85
2028	Cupertino	1893	23.70	------	.75	------	------	------	------
1240	Fresno	1890	26.90	27.13	.39	.40	13.64	.50	2.08
1309	Mission San José	1890	21.70	------	.57	.27	11.09	.34	1.90
1550	Paso Robles	1891	26.35	------	.40	------	------	------	------
1741	Paso Robles	1892	25.20	------	.43	------	------	------	------
1886	Paso Robles	1893	26.00	------	.45	------	------	------	------
1915	Paso Robles	1893	26.70	26.31	.41	.40	13.27	.30	2.30
1806	Amador station	1893	20.00	------	.86	------	------	------	------
2142	Amador station	1894	27.20	------	.44	------	------	------	------
	Average, Cupertino	------	**23.60**	**23.13**	**.55**	**.29**	**13.27**	**.36**	**1.85**
	Average, Paso Robles	------	**25.81**	**26.31**	**.42**	**.40**	**13.27**	**.30**	**2.30**
	Average, Amador station	------	**23.60**	------	**.65**	------	------	------	------
	Grüner Velteliner.								
1108	Cupertino	1889	25.60	25.76	.46	.40	12.82	.48	2.55
1306	Cupertino	1890	25.90	------	.54	.33	------	------	------
2101	Cupertino	1893	28.00	------	.51	------	------	------	------
1208	Fresno	1890	23.30	22.23	.53	.40	11.45	.32	1.80
1454	Fresno	1891	26.60	------	.48	------	12.82	.44	2.95
1605	Mission San José	1891	23.50	24.12	.53	------	12.00	.40	2.15
1346	Mission San José	1890	25.20	------	.51	.30	13.73	.47	2.58
1784	Mission San José	1892	24.25	------	.55	------	------	------	------
1989	Mission San José	1893	24.80	23.61	.60	------	13.09	.57	2.30
2252	Mission San José	1894	23.50	------	.49	------	------	------	------
1803	Amador station	1893	19.30	------	.87	------	------	------	------
	Average, Cupertino	------	**26.50**	**25.76**	**.50**	**.36**	**12.82**	**.48**	**2.55**
	Average, Fresno	------	**24.95**	**22.23**	**.50**	**.40**	**12.13**	**.38**	**2.37**
	Average, Mission San Jose	------	**24.25**	**23.86**	**.53**	**.30**	**12.94**	**.48**	**2.34**
	Rothgipfler.								
1105	Cupertino	1889	28.20	28.07	.46	.34	14.00	.39	2.20
1359	Cupertino	1890	28.00	------	.46	------	------	------	------
1530	Paso Robles	1891	26.50	------	.34	------	------	------	------
1722	Paso Robles	1892	25.20	------	.41	------	------	------	------
1800	Amador station	1893	21.10	------	.87	------	------	------	------
2143	Amador station	1894	28.90	------	.35	------	------	------	------
2238	Mission San José	1894	22.60	------	.49	------	------	------	------
	Average, Cupertino	------	**28.10**	**28.07**	**.46**	**.34**	**14.00**	**.39**	**2.20**
	Average, Paso Robles	------	**25.85**	------	**.37**	------	------	------	------
	Average, Amador station	------	**25.00**	------	**.61**	------	------	------	------
	Peverella.								
1190	Cupertino	1889	20.40	------	.50	.22	9.73	.36	1.55
1406	Cupertino	1890	23.05	------	.87	.27	12.09	.57	2.32
1602	Cupertino	1891	20.85	20.24	.67	.30	10.83	.52	2.05
1426	Mission San José	1890	29.10	------	.92	------	------	------	------
1782	Mission San José	1892	23.15	------	.80	------	------	------	------
2015	Mission San José	1893	23.10	21.22	.94	.23	12.09	.67	2.80
2300	Mission San José	1894	19.75	------	.67	------	------	------	------
1463	Fresno	1891	23.92	22.67	.74	.43	11.73	.48	2.25
1743	Paso Robles	1892	24.35	------	.41	------	------	------	------
1836	Amador station	1893	22.60	------	.89	------	------	------	------
2191	Amador station	1894	26.90	------	.51	------	------	------	------
1941	Tulare	1893	24.40	------	.50	------	------	------	------
2330	Tulare	1894	26.90	------	.38	------	------	------	------
	Average, Cupertino	------	**21.43**	**20.24**	**.68**	**.33**	**10.88**	**.48**	**1.97**
	Average, Mission San Jose	------	**23.77**	**21.22**	**.83**	**.23**	**12.09**	**.67**	**2.80**
	Average, Amador station	------	**24.75**	------	**.70**	------	------	------	------
	Average, Tulare	------	**25.43**	------	**.44**	------	------	------	------

Summary of Analyses of Musts and Wines of Austrian and Hungarian Type—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at Six to Eights Month	Body
	Vernaccia.								
1091	Mission San José	1889	24.36	24.64	.66	.37	------	------	------
1422	Mission San José	1890	28.60	------	.66	------	------	------	------
1781	Mission San José	1892	24 80	------	.65	------	------	------	------
2014	Mission San José	1893	24.80	23.80	.84	.32	------	------	------
2305	Mission San José	1894	22.20	------	.51	------	------	------	------
1148	Cupertino	1889	23.15	21.80	.55	.31	12.09	.40	2.45
1400	Cupertino	1890	25.90	------	.68	------	------	------	------
1601	Cupertino	1891	23.70	23.61	.81	.33	------	------	------
2104	Cupertino	1893	24.80	------	1.07	------	------	------	------
1236	Fresno	1890	23.40	23.13	.53	.33	------	------	------
1549	Paso Robles	1891	22.60	21.80	.32	------	------	------	------
1723	Paso Robles	1892	25.45	------	.36	------	------	------	------
2188	Amador station	1894	24.70	------	.38	------	------	------	------
2328	Tulare	1894	23.30	------	.32	------	------	------	------
	Average, Mission San Jose	------	**25.35**	**24.22**	**.66**	**.34**	------	------	------
	Average, Cupertino	------	**24.36**	**22.70**	**.68**	**.32**	**12.09**	**.40**	**2.45**
	Average, Paso Robles	------	**24.02**	**21.80**	**.34**	------	------	------	------
	Furmint (Mosler).								
2189	Amador station	1894	23.15	------	.38	------	------	------	------
	Zierfahndler.								
1133	Cupertino	1889	23.30	23.13	.47	.33	11.27	.44	2.35
1323	Cupertino	1890	24.35	------	.75	------	------	------	------
2090	Cupertino	1893	24.80	------	.60	------	------	------	------
1314	Mission San José	1890	26.50	------	.41	.40	13.27	.50	------
1577	Mission San José	1891	27.35	------	.33	------	13.75	.32	2.70
2280	Mission San José	1894	20.00	------	.53	------	------	------	------
1760	Paso Robles	1892	18.15	------	.46	------	------	------	------
2279	Amador station	1894	22.60	------	.42	------	------	------	------
	Average, Cupertino	------	**24.15**	**23.13**	**.60**	**.33**	**11.27**	**.44**	**2.35**
	Average, Mission San Jose	------	**24.62**	------	**.42**	**.40**	**13.51**	**.41**	**2.70**
	Rother Steinschiller.								
1174	Mission San José	1889	20.50	20.61	.33	.21	10.36	.57	2.32
1424	Mission San José	1890	23.70	------	.53	------	------	------	------
1783	Mission San José	1892	17.35	------	.73	------	8.46	.48	2.10
1996	Mission San José	1893	21.70	------	.73	------	------	------	------
2016	Mission San José	1893	21.50	20 46	.55	.30	11.18	.68	2.60
1201	Cupertino	1889	19.30	18.89	.24	.23	9.82	.33	1.66
1415	Cupertino	1890	20.60	------	.50	.29	11.09	.45	2.14
2103	Cupertino	1893	21.20	------	.50	------	------	------	------
2068	Paso Robles	1893	21.50	20.99	.43	.27	------	------	------
	Average, Mission San Jose	------	**20.95**	**20.53**	**.57**	**.25**	**10.27**	**.63**	**2.46**
	Average, Cupertino	------	**20.36**	**18.89**	**.41**	**.26**	**10.45**	**.39**	**1.90**
	Slankamenka.								
1197	Cupertino	1889	18.80	17.71	.39	.41	8.07	.46	1.63
1410	Cupertino	1890	18.20	------	.62	------	------	------	------
2092	Cupertino	1893	23.30	------	.59	------	------	------	------
1988	Mission San José	1893	25.95	25.19	.54	.30	12.64	.50	2.60
2228	Mission San José	1894	22.00	------	.55	------	------	------	------
	Average, Cupertino	------	**20.10**	**17.71**	**.52**	**.41**	**8.07**	**.46**	**1.63**
	Average, Mission San Jose	------	**23.65**	**25.19**	**.54**	**.30**	**12.64**	**.50**	**2.60**
	Bakator.								
1319	Cupertino	1890	24.05	------	.71	------	------	------	------
2089	Cupertino	1893	21.50	------	.83	------	------	------	------
1537	Paso Robles	1891	22.60	------	.48	------	------	------	------
1728	Paso Robles	1892	24.80	------	.47	------	------	------	------

Summary of Analyses of Musts and Wines of Austrian and Hungarian Type—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at Six to Eight Months	Body
	Bakator—Continued.								
2080	Paso Robles	1893	24.80	23.61	.44	.32	12.54	.40	2.10
1841	Amador station	1893	18.80	------	.66	------	------	------	------
2179	Amador station	1894	24.80	------	.49	------	------	------	------
2011	Mission San José	1893	20.60	19.90	.80	.25	------	------	------
2232	Mission San José	1894	20.30	------	.62	------	------	------	------
2202	Tulare	1894	25.00	------	.41	------	------	------	------
	Average, Cupertino	------	**22.77**	------	**.77**	------	------	------	------
	Average, Paso Robles	------	**36.06**	**23.61**	**.46**	**.32**	**12.54**	**.40**	**2.10**
	Average, Amador station	------	**21.80**	------	**.57**	------	------	------	------
	Average, Mission San Jose	------	**22.30**	**19.90**	**.61**	**.25**	------	------	------
	Green Hungarian.								
1403	Cupertino	1890	20.40	------	.65	.31	11.45	.57	1.75
2094	Cupertino	1893	20.00	------	.64	------	------	------	------
2004	Tulare	1893	21.50	------	.48	.45	------	------	------
	Average, Cupertino	------	**20.20**	------	**.64**	**.31**	**11.45**	**.57**	**1.75**

PORT TYPE.

(See Vit. Rept. 1887–89, p. 255.)

Though the Portuguese are notoriously careless wine-makers, it is only lately and to a limited extent that we have been able to make Ports which approach their best wines in quality. This is due to a variety of causes. The proper Port grapes have been planted to a very limited extent only. The localities where most of the Ports have been made lack that advantage of soil and situation possessed by the banks of the Douro. Even when Port is made in a good locality it is but too often only an attempt to give a new lease of life to a moribund dry wine, or it is made from grapes which do not possess the composition and characteristics necessary to the production of a good Port. The Ports of the Douro also owe much of their excellence to skillful handling, and especially blending, after fermentation. The wines are partially fortified at the vineyard prior to, during, or immediately after fermentation, and shipped to the large storage cellars. The fermentation is thus sometimes prolonged for months. As the fermentation and fortifying are carried on, as a rule, in a somewhat haphazard way, the wines arrive at the storage cellars with very varying degrees of alcohol and sugar. They are, however, immediately blended and refortified, in order to make a uniform product. The wines are subjected to thorough aëration, both during fermentation and in subsequent handling. This is a point generally neglected in California. It is also worthy of note that all the best Ports are made from a mixture of grapes. This has been the experience with the wines made at the Experiment Stations. No grape, so far tested, makes a thoroughly satisfactory Port alone. Tinta de Madeira is the nearest to being an exception, but even this variety is improved by an addition of Tinta Cão or Mourisco Preto.

Red liqueur wines are not made so commonly as the white, but in most wine-making countries a little is produced. The red Muscats of Italy and the sweetish "auslese" wines of Germany may be included in this group.

TINTA DE MADEIRA.

(See Vit. Rept. 1883–85, p. 140; 1887–89, p. 270.)

Synonym: Negramol.

Description.—Vine fairly vigorous; canes very light-colored; leaves of medium size, obtusely serrate, slightly or not at all lobed, petiolar sinus quite closed, young shoots tomentose, older leaves glabrous above with more or less loose tomentum below; bunches of medium size, conico-cylindrical, generally close, shouldered, on herbaceous peduncles; berries of medium size, juicy, tender-skinned, on slender pedicels.

The Negramol, so called from the soft feel of the berries and the dark color of the skin, according to its reputation in the island of Madeira, should make a deep-colored, very astringent wine. In California it makes a wine with a fair amount of color, which, however, soon deposits and turns yellowish. The astringency varies very much with the locality. In the northern coast counties it is sufficiently high for a dry wine, but in warmer localities the tannin contents are low. The vine bears well with long or half-long pruning, and the grapes attain very regularly a high percentage of sugar. The acid is full for a Port grape, but it is admirably suited to the purpose. It has a smoothness and roundness of flavor which makes it much more desirable for this purpose, used alone, than any of the other Port grapes tried. It is improved, however, by blending with Tinta Amarella or Mourisco preto, and can be recommended for planting as a Port grape with some good bearing variety of less character and lower acidity.

The bunches are almost always perfectly sound, and coulure is very rare.

Analyses of Musts and Wines.

TINTA DE MADEIRA.	Date of Picking	MUST.				WINE.						
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body	Sugar
						By Weight	By Volume		At Pressing	At Six Months		
1890—No. 1247. Fresno	Aug. 24	24.80	24.22	.50	.43	15.25	18.78	.126	.45	.38	4.02	1.40
No. 1301. Mission San José	Oct. 5	23.70	------	.52	.30	9.41	11.73	.241	.53	.38	2.82	------
No. 1363. Cupertino	Oct. 14	27.45	------	.54	.35	16.23	19.96	.164	.56	.53	4.32	.96
1891—No. 1459. Fresno	Aug. 28	24.80	------	.57	------	15.25	18.78	.225	.53	.47	3.25	.23
No. 1487. Paso Robles	Sept. 9	21.50	------	.48	------	------	------	------	------	------	------	------
No. 1567. Mission San José	Oct. 6	24.53	------	.48	------	17.08	20.99	.270	.65	.43	2.95	------
1892—No. 1630. Tulare	Sept. 3	23.70	------	.42	------	16.31	20.06	.126	.50	.44	3.35	1.75
No. 1651. Paso Robles	Sept. 13	25.86	------	.59	------	------	------	------	------	------	------	------
No. 1771. Mission San José	Oct. 13	23.05	22.67	.56	------	14.73	18.14	.136	.63	.50	2.86	1.34
1893—No. 1850. Amador station	Sept. 13	23.90	21.38	.56	.33	13.41	17.26	.096	.56	.68	3.00	2.50
No. 1896. Paso Robles	Sept. 26	26.70	26.31	.39	.37	16.53	21.19	.115	.38	.41	3.22	1.08
No. 1977. Tulare	Oct. 14	24.40	------	.42	.40	------	------	------	.38	------	------	------
No. 2056. Cupertino	Nov. 1	24.80	------	.56	------	------	------	.320	------	------	------	------
No. 2072. Mission San José	Nov. 3	26.30	25.76	.44	.27	------	------	------	------	------	------	------
1894—No. 2146. Amador station	Sept. 13	26.50	------	.48	------	------	------	------	------	------	------	------
No. 2255. Mission San José	Oct. 5	22.60	------	.44	------	------	------	.237	------	------	------	------
No. 2337. Tulare	Oct. 19	25.90	------	.39	------	------	------	------	------	------	------	------

COLOR READINGS.

TINTA DE MADEIRA.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.		Six Months.	
1890—No. 1247.	Fresno	38.8	4VR	12.3	2VR+2Y	11.4	4VR+2Y	7.1	1R+2Y						
No. 1301.	Mission San José	43.4	2VR	24.3	4VR	16.5	5VR	12.1	1R	10.8	3VR+1Y	9.8	5VR+1Y	11.0	4VR+1Y
No. 1363.	Cupertino	34.8	5VR	18.5	5VR+1Y	19.2	1R+1Y	12.5	3R+2Y						
1891—No. 1459.	Fresno	13.3	R	12.2	1R	23.0	1VR+1Y	19.5	2VR+1Y	16.4	5VR+1Y	11.3	3R+1Y		
No. 1567.	Mission San José	111.1	1VR	25.0	R to 1R	28.6	1VR+1Y	25.5	3VR+1Y	22.1	4VR+1Y				
1892—No. 1630.	Tulare	22.8	2VR	12.9	1VR+1Y	12.9	1VR+1Y	14.0	1VR+1Y	14.0	4VR+1Y	12.9	5VR+1Y		
No. 1771.	Mission San José	121.0	2VR	41.6	4VR	22.5	1R	21.6	1R	21.6	1R				
1893—No. 1850.	Amador station	39.2	3VR	22.3	1R	18.5	2R	16.3	2R						
No. 1896.	Paso Robles	22.5	5VR	11.6	3R	13.3	4R								
No. 1977.	Tulare	26.8	4VR												
No. 2056.	Cupertino	40.0	4VR												
No. 2072.	Mission San José	62.5	2VR												

RECORD OF TREATMENT.

No. 1247. *Tinta de Madeira*, from Fresno. Received August 27, 1890, in fair condition, and quite mature. The must showed 24.8% of solid contents by spindle and 0.50% of acid. The grapes were crushed at a temperature of 67°, and placed in a room which was kept at a temperature of between 91° and 98°. The wine fermented strongly, and reached a maximum temperature of 95° on the second day. On the third day the pomace was pressed and the wine fortified with 70% spirits.

At five months the wine was quite bright, but tasted raw. It was racked and put in a heating-chamber at a temperature of 110°, where it remained for three months. One month after removal from the heating-chamber the wine was clear, very well constituted, but somewhat coarse and rough. At eighteen months the wine was racked for the fourth time. It was a very fair Port, with rich bouquet and some flavor, much toned down and improved. After this it did not improve, being in too small a quantity to keep well.

No. 1301. *Tinta de Madeira*, from Mission San José. Received October 7, 1890, in poor condition, many of the grapes being moldy. The grapes were crushed and fermented as dry wine. The temperature at crushing was 71°, and the maximum reached was 90°, on the third day. On the sixth day the wine was dry and was pressed.

One month after crushing the wine was nearly clear. At two months the wine was fermenting a little and had a slightly bitter taste, but the lees appeared sound on microscopic examination. It was nearly clear, of full and pleasing flavor, low acid, full astringency, good body, and a slightly moldy odor. After this it deteriorated and showed poor keeping qualities.

No. 1363. *Tinta de Madeira*, from Cupertino. Received October 17, 1890, in good condition, and mature. The must showed 27.45% of solid contents by spindle and 0.54% of acid. The temperature of the grapes at crushing was 65°, and the maximum reached was 94°, on the third day. On the fourth day the wine was drawn off and fortified.

Three months after pressing the wine was not quite clear, tasteless, and of low quality. It was racked and put in a heating-box, at a temperature of 110°, where it was left for three months. One month after taking from the heating-chamber it was improved in flavor, but still not clear or clean-tasting. It was then racked for the third time. At sixteen months it was clear and had developed a little bouquet, but was without flavor, a little bitter, and poor generally. A year later it had improved somewhat, but was at best only a second-rate Port. At four years it had improved a little more and was put in glass. Fourteen months after putting in glass the wine was much improved, and was an agreeable Port with some bouquet, little flavor; a smooth, neutral wine, without positive defect, but lacking in character, and very light in color.

No. 1459. *Tinta de Madeira*, from Fresno. Received August 31, 1891, in good condition. The must showed 24.8% of solid contents by spindle and 0.57% of acid. Only a small quantity of grapes was crushed, and the temperature of the must varied from 66° at crushing to 84° on the fifth day. On the fifth day the wine was drawn off the pomace, and on the sixth day fortified with 70% spirits.

Four months after pressing the wine was bright, of good flavor and color, and clean-tasting, but a little too dry. Two months later it was racked and put in the heating-chamber, at a temperature of from 90° to 95°, where it was left for three months. At three years it had marked Port character, but was too dry and a little bitter. At four years it was a Port of very marked character, with strong bouquet and flavor. It was of too pronounced character for use alone, and required toning-down by blending.

No. 1487. *Tinta de Madeira*, from Paso Robles station. A sample for must analysis was received September 11, 1891, in good condition. The must showed 21.5% of solid contents by spindle and 0.48% of acid.

No. 1567. *Tinta de Madeira*, from Mission San José. Received October 9, 1891, in fair condition, and mature. The must showed 24.53% of solid contents by spindle and 0.48% of acid. The temperature of the grapes at crushing was 60°, and the maximum reached was 84°, on the fourth day. The wine was drawn off on the fourth day, and fortified on the sixth.

Three months after pressing the wine was clear, of good color and full flavor, but rather too dry. A month later it was racked and put in the heating-chamber, at a temperature of from 90° to 95°, where it remained three months. At thirteen months it was in good condition, and had improved. It was rather lacking in flavor, but the bouquet was good and the sweetness had increased to the right degree by evaporation. At four years it was an agreeable Port, with less character and more color than wine from the same grape from Fresno, and had a slight but not unpleasant bitterness.

No. 1630. *Tinta de Madeira*, from Tulare station. Received September 6, 1892. There is some doubt as to the identity of this lot. The grapes came mixed with Tinta Amarella, and appeared to be Tinta de Madeira, though in the absence of leaves its identity was uncertain. The grapes were in good condition, and mature. The temperature at crushing was 69°, and the maximum reached was 85°, on the third day. On the fourth day the wine was drawn off and fortified.

At three months the wine was bright and of good quality, but rather too dry. At six months it was racked, sweetened and refortified, and put in the heating-chamber, at a temperature of from 90° to 95°, where it was left for three months. At one year it was in good condition, a full-flavored, clean-tasting, and very agreeable Port. At three years the wine retained its good qualities, and had improved. It was less marked in character than the wine from the same grape from Fresno, but was better wine to use unblended.

No. 1651. *Tinta de Madeira*, from Paso Robles station. A sample for must analysis was received September 16, 1892, in good condition. The must showed 25.86% of solid contents by spindle and 0.59% of acid.

No. 1771. *Tinta de Madeira*, from Mission San José. Received October 15, 1892. The must showed 23.05% of solid contents by spindle and 0.56% of acid. The temperature of the must at crushing was 58°, and the maximum reached was 85°, on the fourth day. The wine was dry on the fifth day, when it was drawn off and fortified.

At one month the wine was clear, and at two months it was bright and promising. At five months it was racked for the third time, sweetened, fortified, and put in the heating-chamber, where it was kept at a temperature of from 90° to 95° for three months. At nine months it was bright and of good quality. At two years it was somewhat lacking in flavor and too acid. At four years it was much improved in bouquet and flavor, very clean-tasting, but a little thin, and required blending with a heavier wine.

No. 1850. *Tinta de Madeira*, from Amador station. Received September 15, 1893, in good condition. The bunches and grapes were very small, and showed damage from *oidium*. The must showed 23.9% of solid contents by spindle and 0.56% of acid. The grapes were fermented in a temperature of from 80° to 85°. On the fifth day the wine was drawn off and fortified. The wine did not turn out well, and was without color or character.

No. 1896. *Tinta de Madeira*, from Paso Robles station. Received September 28, 1893, in good condition, and mature. The must showed 26.7% of solid contents by spindle and 0.39% of acid. The bunches were small and compact; the berries small and with little color. The temperature of the must at crushing was 66°, and the maximum reached was 90°, on the fourth day. On the fifth day the wine was drawn off and fortified.

At two months the wine was bright and well constituted. It was racked and put into the heating-chamber, at a temperature of from 90° to 95°, where it was kept for three months. At two years it was a smooth and agreeable Port, with some bouquet and flavor, but not very well developed.

No. 1977. *Tinta de Madeira*, from Tulare station. A sample for must analysis was received October 16, 1893, in good condition, and mature. The bunches were rather small, conical, well filled, but not compact; berries of medium size, slightly oval, very soft, and juicy. The must showed 24.4% of solid contents by spindle and 0.42% of acid.

No. 2056. *Tinta de Madeira*, from Cupertino. A sample for must analysis was received October 30, 1893, in good condition. The bunches were small, irregular, well filled; berries small, juicy, and very ripe. The must showed 24.8% of solid contents by spindle and 0.56% of acid.

No. 2072. *Tinta de Madeira*, from Mission San José. A sample for must analysis was received November 3, 1893, in good condition. The bunches were under medium size, conical, with small wings, and well filled; the berries were small, round, pulpy, but soft and thin-skinned, and quite mature. The must showed 26.3% of solid contents by spindle and 0.44% of acid.

TINTA AMARELLA.

(See Vit. Rept. 1883-85, p. 140; 1887-89, p. 260.)

Description.—Vine a strong grower; bunches large, pyramidal or conical, heavily shouldered, close; berries medium size, but irregular, varying from very small to rather large, and from nearly round to distinctly oval; skin rather thick, but not tough; flesh firm, but juicy; flavor sweet, not marked; peduncle thick, strong, and woody; pedicels rather long and of medium strength.

The Tinta Amarella has maintained its Portuguese reputation as a heavy producer at all the stations except Amador; it requires a richer soil than that in which it is planted there. It is a good grape to plant for the bulk of a Port vineyard, but requires a certain proportion of some variety of higher quality to give it smoothness and character. It makes a good blend with Tinta de Madeira. It is unsuited to the production of dry wine, unless used in small quantities with a grape of more quality, astringency, and better keeping qualities.

ANALYSES OF MUSTS AND WINES.

TINTA AMARELLA.		Date of Picking	MUST.				WINE.						
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body	Sugar
1890—No. 1340.	Mission San José	Oct. 11	22.60	------	.81	.30	9.20	11.45	.107	.62	.44	2.58	------
No. 1388.	Cupertino	Oct. 18	24.25	------	.72	------	9.92	12.36	.210	.60	.51	------	.56
1891—No. 1442.	Tulare	Aug. 26	22.90	------	.51	------	------	------	------	------	------	------	------
No. 1457.	Fresno	Aug. 28	23.70	23.13	.66	.42	13.15	16.24	------	.56	------	3.00	------
No. 1486.	Paso Robles	Sept. 9	21.50	------	.61	------	------	------	------	------	------	------	------
No. 1566.	Mission San José	Oct. 6	23.05	------	.71	------	15.50	19.08	.206	.77	.49	3.28	3.07
1892—No. 1629.	Tulare	Sept. 3	20.85	20.24	.64	.45	17.17	21.09	.093	.56	.53	3.40	1.70
No. 1673.	Tulare	Sept. 16	22.25	21.22	.60	.40	8.48	10.38	.096	.53	.44	3.45	------
No. 1753.	Paso Robles	Oct. 11	22.00	------	.34	------	------	------	------	------	------	------	------
No. 1770.	Mission San José	Oct. 13	21.80	21.38	.86	------	13.85	17.08	.170	.80	.61	2.95	2.00
1893—No. 1878.	Amador station	Sept. 12	18.20	------	.78	.33	------	------	------	.67	------	------	------
No. 1891.	Tulare	Sept. 23	23.70	21.38	.41	.48	------	17.40	.106	.40	------	3.40	0.50
No. 1897.	Paso Robles	Sept. 26	23.70	23.61	.44	.37	------	19.15	.150	.56	.53	3.35	1.25
No. 2059.	Cupertino	Oct. 28	24.60	------	.65	------	------	------	.240	------	------	------	------
No. 2073.	Mission San José	Nov. 3	23.30	21.80	.66	.31	8.98	11.18	.163	.68	.57	2.90	------
1894—No. 2181.	Amador station	Sept. 24	23.90	23.13	.54	------	------	------	.089	------	------	------	------
No. 2291.	Tulare	Oct. 11	24.00	23.13	.49	------	------	------	------	------	------	------	------
No. 2308.	Mission San José	Oct. 13	22.20	------	.62	------	------	------	------	------	------	------	------

RECORD OF TREATMENT.

No. 1340. *Tinta Amarella*, from Mission San José. Received October 14, 1890, in good condition, and mature. The must showed 22.6% of solid contents by spindle and 0.81% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 92°, on the fourth day. At the end of the fourth day the wine was dry, and was drawn off.

The wine remained turbid for some time, and was not clear one month after pressing, when it was racked for the first time; it tasted dry, however, and an examination of the lees showed no unsound germs. At six weeks it was clear, with delicate aroma, clean taste, low acid, and medium astringency. At three months, when the wine was racked for the second time, it was bright and of good quality; the lees showed no unsound germs. Two months later, however, the lees showed some short filaments and the taste of the wine was slightly affected. The wine was then pasteurized, and two months later was bright, very smooth and pleasant, with little character, but sound-tasting. At nine months it was racked for the fourth time. At fifteen months it was bright and nearly or quite mature; it showed little bouquet, but was pleasantly flavored and of agreeable astringency. Two months later it was racked and a part put in bottle; at twenty-three months the rest was bottled. Sixteen months after the second bottling both samples were bright, well flavored, but not delicate; the first bottled was not quite clean-tasting, but the other was a sound, fair wine. Two years later the wine was bright and had retained its color well, but otherwise had deteriorated, showing poor keeping qualities.

No. 1388. *Tinta Amarella*, from Cupertino. Received October 21, 1890, in good condition, and perfectly ripe. The bunches were large and well filled, and some of the berries were beginning to shrivel. The must showed 24.25% of solid contents by spindle and 0.72% of acid. The temperature of the must at crushing was 71°, and the maximum reached was 95°, on the third day. Before the wine was quite dry, six gallons were drawn off and fortified; the remainder was dry on the fourth day, when it was pressed.

At one month the wine was nearly clear, of good aroma, full astringency, and medium acid. At six weeks the lees were examined and found to be sound; the wine was clear, and was racked. At three months the wine was clear, but had a suspicious odor, and an examination of the lees showed unsound germs. The wine was pasteurized, and four months later was bright; it was rather a good wine, with little character, but without positive defect. At eight months it was racked again, and at fifteen months had improved considerably. It was bright, of light color, very little bouquet, but clean and agreeable taste. It was mature, and two months later was racked again and part put in glass; at two years the rest was bottled. Fourteen months after the second bottling both samples were bright; the first bottled was not quite clean-tasting, but the second was a good, common wine, agreeable, but not delicate. Two years later both samples were perfectly bright, but had deteriorated very much.

No. 1442. *Tinta Amarella*, from Tulare station. A sample for must analysis was received August 29, 1891, in good condition. The must showed 22.9% of solid contents by spindle and 0.51% of acid.

No. 1457. *Tinta Amarella*, from Fresno. Received August 31, 1891, in fair condition. The must showed 23.7% of solid contents by spindle and 0.66% of acid. The grapes were fermented in two equal lots. The first (No. 1457) was fermented in the ordinary way. The temperature of the grapes at crushing was 76°, and the maximum reached was 82°, on the third day. On the sixth day, when the wine was still a little sweet, it was drawn off and fortified. The second lot (No. 1457*a*) was started in the same way and at the same temperature. On the third day, when it first showed signs of vigorous fermentation, 9% of spirits of 70° strength was added. This addition of alcohol caused the fermentation to proceed more slowly, and the wine was three days longer in dropping to the required degree of sweetness. The wine was drawn off at the same time as the first lot, allowed to ferment for three days in the barrel, and was then fortified in the same way.

No. 1457. At four months the wine was bright, with good aroma, but tasted rough, a little bitter, and too dry. At five months it was racked, and placed in the heating-chamber, at from 90° to 95°, for three months. When the wine was three years old it was in excellent condition, had good aroma and clean taste, but was not quite equal to No. 1457*a*. Fourteen months later it differed little from No. 1457*a*; both were very creditable Ports, and had lost much of the rough, somewhat coarse character they had when young.

No. 1457*a*. At four months the wine was bright, somewhat raw, with a slightly bitter taste, and too dry. At five months it was racked, and placed in the heating-chamber, at a temperature of from 90° to 95°. At three years it was clear, of good aroma, some flavor, of good Port character, though somewhat coarse. Fourteen months later it had improved and become a very good, smooth Port. The color was very light.

No. 1486. *Tinta Amarella*, from Paso Robles station. A sample for must analysis was received September 11, 1891, in good condition. The must showed 21.5% of solid contents by spindle and 0.61% of acid.

No. 1566. *Tinta Amarella*, from Mission San José. Received October 9, 1891, in good condition, and mature. The must showed 23.05% of solid contents by spindle and 0.71%

of acid. The grapes were crushed at a temperature of 60°, and reached a maximum of 73° on the third day, when the wine was drawn off and fortified.

At three months the wine was clear, of full sweetness, and little flavor. A month later it was racked, and two months later put in the heating-chamber, at a temperature of from 90° to 95°, where it remained three months. At three years the wine was clear, light-colored, smooth, and agreeable, with low acid and rather too much sweetness; it was not of very marked aroma, but made a good blend with Ports of more marked character. At four years it had developed some bouquet, and was generally improved. It had a slight but not unpleasant bitterness.

No. 1629. *Tinta Amarella*, from Tulare station. Received September 6, 1892, in good condition, except for a little mold. The must showed 20.85% of solid contents by spindle and 0.64% of acid. The temperature of the grapes at crushing was 69°, and the maximum reached was 84°, on the third day. On the fourth day the wine was drawn off and fortified.

At three months the wine was bright, clean-tasting, with little color and rather too dry. Three months later it was racked for the second time and placed in the heating-chamber, at a temperature of from 90° to 95°, for three months. When the wine was two years old it was in good condition, and more highly flavored than Tinta de Madeira from the same locality. A blend of Tinta Amarella and Tinta de Madeira in equal parts was much better than either alone. Two years later it had improved very much, was very marked in character, a little bitter, but a good Port and very smooth.

No. 1673. *Tinta Amarella*, from Tulare station. Received September 19, 1892, in good condition. The grapes were very large and fine. The must showed 22.25% of solid contents by spindle and 0.60% of acid. The grapes were crushed at a temperature of 67°, and the maximum of 85° was reached on the third day. On the fourth day the wine was pressed.

The wine was clear in one month, and was racked and taken to the cellar. At three months it was bright, smooth, and pleasing, with little flavor, low acid, and medium astringency. Two months later it was in good condition, and was racked for the second time; it was of poor color. At eight months it was in good condition, clean-tasting, and pleasing. Two months later it was bright and sound, but tasted somewhat flat. At fifteen months it was in good order, but had deteriorated, and was not a success as a dry wine. A month later it was bottled. Two years after bottling the wine was bright and without deposit, but was of poor quality. It had developed something of the Port character, but was evidently a poor keeper and not to be recommended as a dry wine.

No. 1753. *Tinta Amarella*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 22.0% of solid contents by spindle and 0.34% of acid.

No. 1770. *Tinta Amarella*, from Mission San José. Received October 15, 1892, in good condition. The must showed 21.8% of solid contents by spindle and 0.86% of acid. The temperature of the grapes at crushing was 58°, and the maximum reached was 86°, on the fourth day. The wine was drawn off and fortified on the fifth day.

At one month the wine was clear, and was racked off. A month later it was bright and clean-tasting, but too dry. At five months it was racked for the second time, sweetened, and put in the heating-chamber, at a temperature of from 90° to 95°, where it was left for three months. At nine months it was bright, clean-tasting, and well developed. It requires the addition of a smoother wine; makes a good blend with No. 1771, Tinta de Madeira, and also with No. 1674, Mourisco preto. Two years later the wine was fairly good, but too acid and with little Port character. It had kept its color well.

No. 1878. *Tinta Amarella*, from Amador station. Received September 15, 1893, in good condition, but not mature. The bunches were small, the berries varying in size. The must showed 18.2% of solid contents by spindle and 0.78% of acid. There were only 26 lbs. of grapes, and they were made into Port.

At three months the wine was bright and of sufficient sweetness. An analysis showed 4.1% of solid contents and 14% of alcohol. The wine was therefore racked and refortified. Three months later it was racked again, and put into the heating-chamber, at a temperature of from 90° to 95°, for three months. Two months later it was racked again into a demijohn, on account of the small quantity. When the wine was twenty-eight months old it was bright and clean-tasting, but thin and undeveloped. It was, however, a fair wine, considering the unripe grapes from which it was made.

No. 1891. *Tinta Amarella*, from Tulare station. Received September 25, 1893, in good condition; quite mature, very sweet, a few bunches commencing to shrivel. The bunches were conico-cylindrical, slightly or not at all shouldered, compact, and the berries compressed; the berries oval, of medium size, with thick but not tough, well-colored skin, light bloom, soft flesh; the peduncles were thick, and the pedicels rather slender. The vines from which these grapes were gathered were growing in an alkaline soil. Two thirds of the row was in strongly alkaline soil, and the rest in sandy soil with less alkali. The vines were pruned half-long, and bore at the rate of about five tons per acre. The must showed 23.7% of solid contents by spindle and 0.41% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 91°, on the third day. On the third day the wine was drawn off and fortified.

At three months, when the wine was racked for the first time, it was bright and in good order, but not quite sweet enough. At six months it was racked again and put in the heating-chamber, at a temperature of from 90° to 95°, and left there for three months. A month after taking from the heating-chamber it was racked for the third time. At twenty-eight months it was in good order, but still rough and undeveloped; a somewhat coarse Port, but promising.

No. 1897. *Tinta Amarella*, from Paso Robles station. Received September 28, 1893, in fair condition, but somewhat crushed from loose packing, and very dusty. The grapes were mixed with the same variety as the Tulare grapes. These were picked out, and the rest, which were very dusty, washed. The bunches were of medium size, fairly compact; the berries rather small and very sweet. The must showed 23.7% of solid contents by spindle and 0.44% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 84°, on the fourth day. On the fifth day the wine was drawn off and fortified.

At two months and a half the wine was racked; it was bright and too dry. At nine months it was racked again, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. A week after taking from the heating-chamber it was racked again. At twenty-eight months it was in good order, of marked character, but still raw and undeveloped.

No. 2059. *Tinta Amarella*, from Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were of medium size, short conical, close, shouldered; the berries large, nearly round, crisp, quite ripe. The must showed 24.6% of solid contents by spindle and 0.65% of acid.

No. 2073. *Tinta Amarella*, from Mission San José. Received November 3, 1893, in good condition. The bunches were of medium size, conical, shouldered, close; the berries of medium size, round, crisp, juicy, and mature. The must showed 23.3% of solid contents by spindle and 0.66% of acid. The temperature of the grapes at crushing was 60°, and the maximum reached was 88°, on the third day. On the fourth day the wine was dry, and was drawn off.

At one month the wine was not clear and tasted a little bitter. It was racked, and at three months was bright, of good flavor, a little bouquet, good body, low acid, and still slightly bitter. A month later it was racked again, and at six months was much improved, had developed some bouquet, and was in general a pleasant wine. At nine months it was sound and in good order; a smooth, light wine, fresh and clean-tasting, but a little thin. It was racked, and a part put in bottle. At fourteen months it was in good order and mature, but not as good as at nine months. An examination of the lees showed no unsound germs, and the wine was bottled. A year after bottling the wine was bright, of fair quality, but not as good as when examined a year earlier. It had already commenced to become decrepit.

TINTA CÂO.

(See Vit. Rept. 1883–85, pp. 139, 143; 1887–89, p. 266.)

Synonym: Tinta Cam.

Description.—Leaves large, smooth, three-lobed, acuminate, irregularly saw-toothed, with rose-colored petiole, the upper side a green color with some crimson spots, the lower side very slightly downy; canes reddish-colored, bunches not very compact, but of average size and irregular; berries round, bluish-black, pedicels not visible to the end, skin tough and thick, three seeds in the berry; juice sweetish-astringent.

The opinions expressed in the last report regarding the Tinta Câo have been strengthened by subsequent results. For the hot interior valleys it is admirably suited, bearing regularly though not very heavily. It is a very healthy, strong-growing vine, and gives an excellent blending Port. It is somewhat too rough when used alone, but blended with either Tinta de Madeira, Tinta Amarella, or any mild Port variety, it is satisfactory. Blend No. 1772 shows its possibilities as an ingredient in dry red wines. It cannot be recommended for this purpose alone, but if planted for Port in a suitable locality it makes a sufficiently good dry red wine to allow of a change, if dry wine should be desired.

ANALYSES OF MUSTS AND WINES.

TINTA CÂO.		Date of Picking	MUST.				WINE.						
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body	Sugar
							By Weight	By Volume		At Pressing	At Six Months		
1890—No. 1371.	Cupertino	Oct. 14	23.25	------	.52	------	------	------	------	------	------	------	------
No. 1379.	Mission San José	Oct. 18	23.07	------	1.03	.23	9.20	11.45	.222	------	.42	2.78	------
1891—No. 1467.	Fresno	Aug. 29	22.40	21.80	.55	.60	13.77	16.98	.095	------	.18	6.45	3.15
No. 1546.	Paso Robles	Oct. 6	22.70	------	.38	------	------	------	------	------	------	------	------
No. 1568.	Mission San José	Oct. 6	21.10	------	.78	------	13.15	16.24	.210	.75	.50	2.70	------
1892—No. 1697.	Tulare	Sept. 27	22.40	------	.45	------	------	------	------	------	------	------	------
No. 1732.	Paso Robles	Oct. 10	23.50	------	.50	------	------	------	------	------	------	------	------
No. 1769.	Mission San José	Oct. 13	22.80	21.80	.97	------	14.82	18.25	.120	.82	.60	4.20	------
No. 1772.*	Mission San José	Oct. 13	------	------	.63	------	8.84	11.00	.196	.63	.63	2.80	------
1893—No. 1849.	Amador station	Sept. 12	20.60	19.41	.79	.30	------	------	------	.55	------	------	------
No. 1920.	Paso Robles	Oct. 10	24.60	23.61	.56	.34	------	17.00	.100	.52	.69	3.32	0.88
No. 1975.	Tulare	Oct. 14	22.60	------	.71	------	------	------	.413	.69	------	------	------
No. 2051.	Cupertino	Oct. 30	24.60	------	.72	------	------	------	.246	------	------	------	------
1894—No. 2167.	Amador station	Sept. 19	25.40	23.61	.48	------	------	------	------	.48	------	------	------
No. 2275.	Mission San José	Oct. 5	20.20	------	.71	------	------	------	.166	.65	------	------	------
No. 2338.	Tulare	Oct. 19	26.50	------	.40	------	------	------	------	------	------	------	------

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*Blend of the Tinta Câo, Tinta de Madeira, and Tinta Amarella.

Record of Treatment.

No. 1371. *Tinta Câo*, from Cupertino. A sample for must analysis was received October 17, 1890, in fair condition, a few of the berries being moldy. The must showed 23.25% of solid contents by spindle and 0.52% of acid.

No. 1379. *Tinta Câo*, from Mission San José. Received October 20, 1890, in good condition, and mature. The bunches and berries were very small. The must showed 23.07% of solid contents by spindle and 1.03% of acid. The temperature of the grapes at crushing was 68°, and the maximum reached was 90°, on the third day. On the fourth day the wine was dry, and was drawn off.

At one month the wine was nearly clear, and showed high acid and astringency, but the odor was not good and it was not clean-tasting. The lees were examined under the microscope, and as no unsound germs were found the wine was racked and taken to the cellar. At three months the lees were examined again and showed unsound germs. The wine was bright, and the flavor had improved, but the odor was still suspicious, so it was pasteurized. Three months after pasteurizing it was bright, had much improved in bouquet, and the disagreeable odor had almost disappeared. At this time it was racked for the third time, and at fourteen months it was clear, but had deteriorated. Two months later it was bottled, but did not keep well. Two years after bottling it showed some good qualities, but was not clean-tasting.

No. 1467. *Tinta Câo*, from Fresno. Received August 31, 1891, in good condition. The must showed 22.4% of solid contents by spindle and 0.55% of acid. The temperature of the grapes at crushing was 70°, and the maximum reached was 81°, on the third day. On the fourth day it was drawn off, and on the fifth day fortified.

At four months the wine was clear, of good flavor, but slightly bitter; it was of poor color and too dry. A month later it was racked, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At fourteen months it was racked again. At three years it was very much reduced by evaporation, on account of the thinness of the keg; it was not quite clear, but possessed good flavor and aroma and the right amount of sweetness. It was a good Port, but rather coarse and with a slight bitterness. Fourteen months later it had improved and was a Port of marked character, not very delicate, but excellent as a blend to give character to more neutral wines.

No. 1546. *Tinta Câo*, from Paso Robles station. A sample for must analysis was received October 8, 1891, in good condition, and mature. The bunches were very small; the berries also very small and seedy. The must showed 22.7% of solid contents by spindle and 0.38% of acid.

No. 1568. *Tinta Câo*, from Mission San José. Received October 9, 1891, in good condition, and mature. The must showed 21.1% of solid contents by spindle and 0.78% of acid. The temperature of the grapes at crushing was 60°, and the maximum reached was 84°, on the fourth day. On the fifth day the wine was drawn off, and on the sixth fortified.

At three months the wine was clear, but tasted too acid and was too dry. A month later it was racked, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At one year it was racked for the third time. At three years the wine was in good order, but was a thin, poor wine, with very little Port character; on account of the small quantity, it was put in a demijohn. Fourteen months later it had improved, and had developed some bouquet. It was rather thin, but was otherwise a good Port.

No. 1697. *Tinta Câo*, from Tulare station. A sample for must analysis was received September 29, 1892, in good condition. The must showed 22.4% of solid contents by spindle and 0.45% of acid.

No. 1732. *Tinta Câo*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 23.5% of solid contents by spindle and 0.50% of acid.

No. 1769. *Tinta Câo*, from Mission San José. Received October 15, 1892, in good condition. The must showed 22.8% of solid contents by spindle and 0.97% of acid. The temperature of the grapes at crushing was 58°, and the maximum reached was 80°, on the fourth day. On the fifth day the wine was drawn off and fortified.

The wine was clear at three weeks after pressing, and was racked at one month. At two months it was bright and clean-tasting, but too dry and with little Port character. It was racked again, and two months later sweetened and refortified. At twelve months it was racked again and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. A year later it was sound and in good order, but was not an agreeable wine; it was too acid and rough, and had little of the Port character. Thirteen months later it had improved, was of good color, and had developed some bouquet; it was, however, much less marked in character than the Tinta Câo from Tulare.

No. 1772. A blend was made of the grapes of Nos. 1769, 1770, and 1771, in the proportions of Tinta Câo, 21.4%; Tinta Amarella, 57.2%; Tinta Madeira, 21.4%. The temperature of the grapes at crushing was 58°, and the maximum reached was 92°, on the fifth day. The wine was dry on the sixth day, and was drawn off.

At three weeks the wine was quite dry and nearly clear. It was racked, and in three months was bright, of good flavor and some bouquet, fresh-tasting, with full acid and medium astringency. Three months later it was racked again, being in good condition and improved in character. At eight months it was in good order, and showed excellent promise. Two months later it still tasted a little raw, but was of good bouquet and clean-tasting. At four months it had improved, but was not mature. At eighteen months it was bottled. Twenty months after bottling the wine was bright, without deposit, good, sound, and of neutral character, of good color, acid, and astringency. A good table wine, but not of high quality.

No. 1849. *Tinta Câo*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition. The bunches were small and loose; the berries small and not quite mature. The must showed 20.6% of solid contents by spindle and 0.79% of acid.

No. 1920. *Tinta Câo*, from Paso Robles station. Received October 12, 1893, in good condition. The bunches were small and rather loose, no coulure; the berries small, round, well-colored, fleshy, mature. The must showed 24.6% of solid contents by spindle and 0.56% of acid. The temperature of the grapes at crushing was 69°, and they were fermented for four days, when they were pressed and the wine fortified while still a little sweet.

At two months the wine was bright and a little too dry. It was racked at this date, and again six months later, when it was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. It was racked a week after taking from the heating-chamber. At twenty-seven months it was bright, of full Port flavor, but still rough and undeveloped.

No. 1975. *Tinta Câo*, from Tulare station. A sample for must analysis was received October 16, 1893, in good condition. The bunches were very small, loose, shortly conical; berries very small, round, thick-skinned, mature, except for some second-crop bunches. The must showed 22.6% of solid contents by spindle and 0.71% of acid.

No. 2051. *Tinta Câo*, from Cupertino. A sample for must analysis was received October 31, 1893, in good condition, mature, and very sweet. The bunches were small, branching, and well filled; the berries small, firm, and juicy. The must showed 24.6% of solid contents by spindle and 0.72% of acid.

MOURISCO PRETO.

(See Vit. Rept. 1883–85, p. 140; 1887–89, p. 265.)

Synonyms: Mourisco tinto do Douro; Nova Rei.

Description.—Trunk vigorous, with thick and but slightly adherent bark, which is not much ribboned. The growth starts regularly after the middle of March; the young shoots are but slightly pubescent and of a light color. The canes are strongly inclined, short, with internodes averaging about 3, but occasionally as much as 4¾ inches; nodes small and somewhat flattened. Color of bark, light brown and uniform; wood hard, with little pith. Leaves large, of uniform size, almost round; some five-lobed, with the lateral sinuses but slightly open, while the basal one is widely open; margin with large but rather obtuse teeth. The upper surface of the leaf is smooth, glabrous, brightly and uniformly green; the lower surface is a little rough, hardly pubescent, pale green, and the principal veins strongly marked. Petiole medium length, thick, smooth, whitish-green. Bunches numerous, mostly large, sometimes very large, pyramidal in form, more or less branched; peduncle large, thick, rather soft, light or yellowish green. Berries large, almost uniform in size, regular, flattened, and umbilicate, dull black, adhering strongly to the pedicels, which are long and nearly smooth; flesh quite firm, skin thick, juice sweet and very agreeable. It yields about 55% of juice. It matures late in the second period.

The Mourisco preto was for a time considered as resistant to the attacks of phylloxera, but, like the Flame Tokay, it soon proved to be only partially and insufficiently so. It is a very vigorous, healthy vine, and one of the most promising Port varieties so far tested in California. It bears well and produces a good Port, both at Tulare and Paso Robles, being for this purpose superior to the Tinta Amarella. It attains a good amount of sugar, and is marked by low acid and low tannin. It is quite unsuited for dry wines, but the composition of the must and the general character of the grape render it eminently fitted for Port.

ANALYSES OF MUSTS AND WINES.

MOURISCO PRETO.		Date of Picking	MUST.				WINE.						
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body	Sugar
							By Weight	By Volume		At Pressing	At Six Months		
1892—No. 1674.	Tulare	Sept. 20	22.40	22.67	.32	.39	14.55	17.92	.083	.41	----	3.61	1.75
1893—No. 1923.	Paso Robles	Oct. 10	25.40	24.12	.47	.42	9.20	11.45	----	.50	.41	2.30	----
No. 1968.	Tulare	Oct. 14	23.90	23.13	.47	.56	----	18.30	.066	.45	.49	3.26	.34
1894—No. 2185.	Amador station	Sept. 24	25.20	----	.44	----	----	----	----	----	----	----	----
No. 2321.	Tulare	Oct. 15	25.00	----	.54	----	----	----	----	----	----	----	----

Record of Treatment.

No. 1674. *Mourisco preto*, from Tulare station. Received September 21, 1892, in good condition, and mature. The must showed 22.4% of solid contents by spindle and 0.32% of acid. The temperature of the grapes at crushing was 67°, and the maximum reached was 82°, on the third day. The wine was drawn off on the fifth day, while still a little sweet, and fortified.

In six weeks the wine was clear, and in two months bright. It showed a good Port flavor, but was rather too dry. At five months it was sweetened, refortified, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. A month after taking from the heating-chamber it was in good condition, of good flavor and very decided Port aroma. It made an excellent blend with one half Tinta de Madeira. When the wine was two years old it was in good condition, a somewhat coarse, heavy-flavored Port, requiring blending with a neutral or more delicate wine. Thirteen months later it had improved, was of good color, had become smoother, and developed a good bouquet.

No. 1923. *Mourisco preto*, from Paso Robles station. Received October 12, 1893, in good condition, quite mature, but not shriveled. The bunches were small, irregular, rather loose; the berries small, round, fleshy, with little juice. The must showed 25.4% of solid contents by spindle and 0.47% of acid. The grapes were crushed at a temperature of 69°, and fermented for four days, when they were fortified while still a little sweet.

In one month the wine was bright, but was rather too dry. At five months it was racked for the second time, and placed in the heating-chamber, at a temperature of from 90° to 95°, for three months. It was racked again two months after taking from the heating-chamber. At twenty-seven months it was not bright, was rough, and still tasted raw; it was of poor color, but had a good and full Port aroma.

No. 1968. *Mourisco preto*, from Tulare station. Received October 16, 1893, in good condition, but some were not quite mature. The bunches were conical, shouldered, and loose; the berries of medium size and nearly round. The must showed 23.9% of solid contents by spindle and 0.47% of acid. The grapes were crushed at a temperature of 68°, and reached a maximum of 78° on the second day. On the third day the wine was drawn off, and on the fifth day was fortified.

At one month the wine was racked; it was bright and too dry. At eight months it was put in the heating-chamber, at a temperature of from 90° to 95°, for three months At eleven months it was racked for the third time. At twenty-seven months it was bright, of poor color, too dry and still raw, but of full Port aroma and promising.

MISSION.

Description.—Vine vigorous and a heavy grower; leaves of medium size, shiny green and glabrous above, downy below, barely lobed, acutely toothed, on reddish petioles; bunches large, pyramidal, spreading, loose; berries of medium size, round, crisp, brownish-red.

The suggestion of Mr. Charles A. Wetmore that the Mission is the same as the Monica, the most valued grape of Sardinia, is interesting, but we believe not quite correct. The Monica has been cultivated at the Experiment Stations for four years, but has only fruited once. It can be distinguished at first glance from the Mission by the yellowish-green of its foliage and the decided pink of the tips of the growing shoots. The young leaves are more deeply bronzed, and the older leaves are more densely woolly (tomentose) below, and lose the down of the upper surface more slowly. The grapes as grown at Tulare are much larger, finer, and of more agreeable flavor than those of the Mission grape. With these exceptions there is certainly a very close resemblance between the varieties, which shows that they are very closely connected. It is possible that years of cultivation and unconscious selection in California may be the cause of the differences, but we think it more probable that the Mission is a seedling of the Monica. There is little to be said in favor of our old, rejected friend, the Mission, except that it may still be useful in some localities as an ingredient in Sherries. Its total lack of character and low acid render it unfit for any other purpose than blending where a neutral ingredient is desired.

ANALYSES OF MUSTS AND WINES.

MISSION.	Date of Picking	MUST.				WINE.						
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body	Sugar
						By Weight	By Volume		At Pressing	At Six Months		
1890—No. 1256. Amador station	Sept. 23	22.20		.44	.31	9.56	11.91	.168	.40	.38	2.52	------
1892—No. 1692. Tulare	Sept. 26	25.90	------	.38	------	------	------	------	------	------	------	------
No. 1720. Paso Robles	Oct. 10	23.25	23.13	.42	------	16.31	20.06	------	.37	------	2.57	2.23
1893—No. 1870. Amador station	Sept. 12	20.40	------	.48	------	------	------	.154	.68	------	------	------
No. 1978. Tulare	Oct. 19	26.30	25.53	.38	.57	8.98	11.18	- - -	.39	.42	2.45	------

COLOR READINGS.

MISSION.	At Pressing.	One Month.	Two Months.	Three Months.
1890—No. 1256. Amador station	11.1 VR+2Y	4.8 3R+2Y	4.9 1R+2Y	*
1893—No. 1870. Amador station	12.3 1VR+1Y	10.7 2VR+1Y	------	------

*Too light for instrument.

RECORD OF TREATMENT.

No. 1256. *Mission*, from Amador station. Received September 26, 1890, in good condition. The bunches were of medium size, pyramidal and loose, with small shoulders; berries medium to small, round, not quite mature. The must showed 22.2% of solid contents by spindle and 0.44% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 77°, on the fifth day. On the seventh day the wine was drawn off, though it was still very sweet.

Three weeks after pressing it showed no signs of fermentation, but was still turbid and contained 3% or 4% of sugar. A month later it was still cloudy, and the lees were full of elongated yeast cells, but no unsound germs were observed. The wine was without color, nearly dry, tasteless, and flat. It was racked, and a month later the lees showed unsound germs. The taste of the wine was not affected. It was cloudy, but quite dry and improved in taste. It was pasteurized, but did not improve, and four months later it was cloudy, coarse, and insipid. After this it became gradually worse, and never became quite clear.

No. 1692. *Mission*, from Tulare station. A sample for must analysis was received September 29, 1892, in good condition. The must showed 25.9% of solid contents by spindle and 0.38% of acid.

No. 1720. *Mission*, from Paso Robles station. Received October 13, 1892, in good condition. The must showed 23.25% of solid contents by spindle and 0.42% of acid. The temperature of the grapes at crushing was 68°, and the maximum reached was 74°, on the fourth day. The wine was drawn off on the fourth day and fortified.

At one month the wine was clear, and was racked. At ten weeks it was bright, and was racked; it was clean-tasting, but too sweet. Two months later it was refortified. When twelve months old it was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years it was in good order; it was a fair Sherry, but too sweet and without much character. Thirteen months later it had improved very much; it was a good, clean-tasting Sherry, rather too sweet, and without much aroma, but very pleasing.

No. 1870. *Mission*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition. The bunches were large and loose; the berries uneven in size and degree of ripeness. The must showed 20.4% of solid contents by spindle and 0.48% of acid.

ALEATICO.

Synonym: Uva liatica.

Description.—Vine fairly vigorous and productive in warm locations; leaves longer than wide, glabrous on both sides, irregularly and sharply dentate, the upper sinuses well marked, the lower shallow or absent, on reddish petioles; bunches over medium size, winged, compact when not coulured, on thick peduncles; berries of medium size, round, crisp, and juicy, on thick pedicels; skin reddish-purple, tough. The grapes have a very delicate and agreeable Muscat flavor.

The finest red "vins de liqueur" of Tuscany and Piedmont are made from this variety. It is often blended with other varieties for this purpose, but even when used alone its Muscat flavor is delicate and agreeable. The wine has a fuller astringency than that of other black Muscats, which takes away the somewhat nauseating effect characteristic of many Muscat wines. The vine bears well and ripens its crop early at Tulare, where, however, the grapes easily dry up if not gathered in time. The grapes attain a high percentage of sugar in all localities tested, and maintain their acid well. The grapes from Tulare, which are the only ones which have been tested for wine, make an agreeable and delicate "vin de liqueur."

Analyses of Musts and Wines.

ALEATICO.		Date of Picking	MUST.				WINE.						
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body	Sugar
1890—No. 1368.	Cupertino	Oct. 14	29.50	------	.74	------	------	------	------	------	------	------	----
1891—No. 1548.	Paso Robles	Oct. 6	24.70	------	.44	------	------	------	------	------	------	------	------
1892—No. 1631.	Tulare	Sept. 3	27.80	27.13	.41	.48	14.91	18.36	------	.42	.52	5.80	2.40
No. 1724.	Paso Robles	Oct. 10	25.75	------	.50	------	------	------	------	------	------	------	------
1893—No. 1796.	Tulare	Aug. 29	24.35	23.13	.75	.30	13.86	17.92	------	.54	------	6.70	4.00
No. 1851.	Amador station	Sept. 13	22.20	20.99	.63	.26	13.34	17.08	.125	.59	.62	4.15	1.41
No. 1933.	Paso Robles	Oct. 12	26.60	26.31	.53	.31	------	------	.311	------	------	------	------
No. 2133.	Cupertino	Nov. 5	30.00	------	.62	------	------	------	.266	------	------	------	------
1894—No. 2148.	Tulare	Sept. 11	24.40	------	.60	------	------	------	------	------	------	------	------

Color Readings.

ALEATICO.		At Pressing.		One Month.		Two Months.		Three Months.	
1892—No. 1631.	Tulare	11.4	VR+Y	4.6	VR+2Y	------		------	
1893—No. 1851.	Amador station	20.8	5VR	16.0	VR+Y	9.8	YY	8.7	YY
No. 1933.	Paso Robles	11.8	3R	------		------		------	
No. 2133.	Cupertino	72.8	2VR	------		------		------	

RECORD OF TREATMENT.

No. 1368. *Aleatico*, from Cupertino. A sample for must analysis arrived October 17, 1890, in fair condition. The grapes were somewhat overripe and shriveled; the bunches were of average size, conical, winged, loose, on thick, woody peduncles; the berries round, of medium size, on short but strong pedicels, skin tough, flesh crisp and juicy. The must showed 29.5% of solid contents by spindle and 0.74% of acid.

No. 1548. *Aleatico*, from Paso Robles station. A sample for must analysis arrived October 18, 1891, in good condition. The bunches were of medium size, well filled with fair-sized berries; the latter highly flavored and mature. The must showed 24.7% of solid contents by spindle and 0.44% of acid.

No. 1631. *Aleatico*, from Tulare station. Received September 6, 1892, in good condition but commencing to dry up. The must showed 27.8% of solid contents by spindle and 0.41% of acid. The grapes were crushed at a temperature of 69°, and reached a maximum of 81° on the third day. The wine was drawn off on the fourth day while still fermenting and very sweet, and was fortified on the fifth day.

In two weeks after pressing the wine was clear, and was racked. At three months it was racked for the second time; it was bright, of fair quality, and with slightly Muscat aroma. Three months later it was sweetened and fortified a little more; it was then put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At seven months it had not shown much development. At two years it had improved, and was a very good red sweet wine, of delicate Muscat aroma and clean taste. Eleven months later it had improved, was bright and very smooth and agreeable.

No. 1724. *Aleatico*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The berries were rather large for this variety. The must showed 25.75% of solid contents by spindle and 0.50% of acid.

No. 1796. *Aleatico*, from Tulare station. Received August 31, 1893, in fair condition. The bunches were over medium in size, rather compact. The grapes, which were of slightly Muscat flavor, were crushed for white wine. The must showed 24.35% of solid contents by spindle and 0.75% of acid. The temperature of the must at crushing was 63°, and the maximum reached was 84°, on the fifth day. On the fifth day, when the wine was still a little sweet, it was fortified.

At three months the wine was bright, well flavored, and very sweet. It was racked, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At one year it was racked for the third time. At two years and five months it was bright, of delicate and pleasing Muscat aroma and golden color; a very good "vin de liqueur."

No. 1851. *Aleatico*, from Amador station. Received September 15, 1893, in good condition. The must showed 22.2% of solid contents by spindle and 0.63% of acid. The grapes were crushed, and fermented in the heating-chamber, at a temperature of from 80° to 85°, for five days, when the wine was drawn off and fortified.

At three months the wine was bright and of sufficient sweetness; it was racked and put in the heating-chamber for three months, at a temperature of from 90° to 95°. At eleven months it was racked for the second time. At twenty-seven months it was not quite clear, of agreeable but not marked Muscat aroma, good, clean taste, but rougher and less developed than the Aleatico from Tulare.

No. 1933. *Aleatico*, from Paso Robles station. A sample for must analysis was received October 13, 1893, in fair condition. The bunches were loose, straggling, much coulured and sunburned; the berries irregular in size, of good flavor, and mature. The must showed 26.6% of solid contents by spindle and 0.53% of acid.

No. 2133. *Aleatico*, from Cupertino. A sample for must analysis was received November 6, 1893, in good condition. The bunches were of medium size, conical, close; the berries mostly dried up to raisins. The must showed 30.0% of solid contents by spindle and 0.62% of acid.

MOSCATELLO FINO.

Synonym: Moscatello nero.

Description.—Leaves of medium size, with deep upper and shallow lower sinuses, glabrous above, slightly downy below, and very hairy on the veins, teeth long and sharp; bunches large to very large, long, loose, conico-cylindrical, and winged; berries very large, on long, thin pedicels; skin well colored, thin but tough; flesh soft and juicy, with delicate Muscat aroma.

This variety is of excellent promise as a table-grape. It is a heavy bearer, and produces very fine-looking bunches of dark-colored grapes. It is rather late in bearing, and does not stand the weather very well.

ANALYSES OF MUSTS AND WINES.

MOSCATELLO FINO.	No. 1310. Cupertino.	No. 1919. Tulare.
Date of picking	Oct. 8, 1890	Oct. 7, 1893
Must.		
Solid contents by spindle	21.70	23.30
Acid as tartaric	.63	.53
Ash	.24	.40
Wine.		
Alcohol by weight	14.09	16.08
Alcohol by volume	17.37	19.78
Acid at pressing	.60	.59
Acid at six months	.50	.43
Tannin	.157	.131
Body	3.54	4.20
Sugar	.47	1.37

RECORD OF TREATMENT.

No. 1310. *Moscatello fino*, from Cupertino. Received October 10, 1890, in good condition, except for a few bunches which had commenced to mold. The bunches were large, long, loose, winged, on long, thin, tough peduncles; the berries were very large, but irregular in size, slightly oval, on long, thin pedicels; the skin was thin, black, and rather tough; the flesh soft and juicy. The grapes were mature, and the must showed 21.7% of solid contents by spindle and 0.63% of acid. The temperature of the grapes at crushing was 65°, and the maximum reached was 81°, on the third day. On the third day the wine was drawn off and fortified.

At three months the wine was bright, of agreeable Muscat aroma and flavor, sweetness and alcoholic strength adequate. A week later it was racked and put in the heating-chamber, at a temperature of 100°, for three months. At eight months the wine was not in very good condition, but showed very good flavor. It was racked for the third time, and at sixteen months was clear, with strong and pleasing aroma, but too low in body and too high in acid. It was racked again at this time, but had deteriorated. At two years the wine showed some good qualities, but was rather thin. At this date it was put in glass.

No. 1919. *Moscatello fino*, from Tulare station. Received October 9, 1893, in good condition. The bunches were very irregular and varying in size, well filled, but not compact; the berries uneven in size, varying from very large to medium. The coloring was uneven, some berries being dark-colored, firm, crisp, and well flavored, others light-colored, soft, and flat-tasting. The must showed 23.3% of solid contents by spindle. The temperature of the grapes at crushing was 67°, and the maximum reached was 82°, on the second day. On the third day the wine was drawn off and fortified.

At two months the wine was bright and agreeable; it was racked for the second time, and put in the heating-chamber, at a temperature of 95°, for three months. At nine months it was racked again. At two years and a half the wine was in good condition; it was well developed, of light rose color, delicate Muscat flavor and aroma, clean-tasting, but rather light-bodied.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF PORT TYPE.

Number	LOCALITY.	Vintage of	MUST.				WINE.*		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Tannin	Acid at Pressing	Acid at Six Months
	Tinta de Madeira.								
1247	Fresno	1890	24.80	24.22	.50	.43	.126	.45	.38
1459	Fresno	1891	24.80	------	.57	------	.225	.53	.47
1363	Cupertino	1890	27.45	------	.54	.35	.164	.56	.53
2056	Cupertino	1893	24.80	------	.56	------	.320	------	------
1301	Mission San José	1890	23.70	------	.52	.30	.241	.53	.38
1567	Mission San José	1891	24.53	------	.48	------	.270	.65	.43
1771	Mission San José	1892	23.05	22.67	.56	------	.136	.63	.50
2072	Mission San José	1893	26.30	25.76	.44	.27	------	------	------
2255	Mission San José	1894	22.60	------	.44	------	.237	------	------
1487	Paso Robles	1891	21.50	------	.48	------	------	------	------
1651	Paso Robles	1892	25.86	------	.59	------	------	------	------
1896	Paso Robles	1893	26.70	26.31	.39	.37	.115	.38	.41
1630	Tulare	1892	23.70	------	.42	------	.126	.50	.44
1977	Tulare	1893	24.40	------	.42	.40	------	.38	------
2337	Tulare	1894	25.90	------	.39	------	------	------	------
1850	Amador station	1893	23.90	21.38	.56	.33	.096	.56	.68
2146	Amador station	1894	26.50	------	.48	------	------	------	------
	Average, Fresno	------	**24.80**	**24.22**	**.53**	**.43**	**.176**	**.49**	**.43**
	Average, Cupertino	------	**26.12**	------	**.55**	**.35**	**.242**	**.56**	**.53**
	Average, Mission San Jose	------	**24.03**	**24.21**	**.48**	**.28**	**.221**	**.60**	**.43**
	Average, Paso Robles	------	**24.68**	**26.31**	**.73**	**.37**	**.115**	**.38**	**.41**
	Average, Tulare	------	**24.66**	------	**.40**	**.40**	**.126**	**.44**	**.44**
	Average, Amador station	------	**25.20**	**21.38**	**.52**	**.33**	**.096**	**.56**	**.68**
	Tinta Amarella.								
1388	Cupertino	1890	24.25	------	.72	------	.210	.60	.51
2059	Cupertino	1893	24.60	------	.65	------	.240	------	------
1340	Mission San José	1890	22.60	------	.81	.30	.107	.62	.44
1566	Mission San José	1891	23.05	------	.71	------	.206	.77	.49
1770	Mission San José	1892	21.80	21.38	.86	------	.170	.80	.61
2073	Mission San José	1893	23.30	21.80	.66	.31	.163	.68	.57
2308	Mission San José	1894	22.20	------	.62	------	------	------	------
1442	Tulare	1891	22.90	------	.51	------	------	------	------
1629	Tulare	1892	20.85	20.24	.64	.45	.093	.56	.53
1673	Tulare	1892	22.25	21.22	.60	.40	.096	.53	.44
1891	Tulare	1893	23.70	21.38	.41	.48	.106	.40	------
2291	Tulare	1894	24.00	23.13	.49	------	------	------	------
1457	Fresno	1891	23.70	23.13	.66	.42	------	.56	------
1486	Paso Robles	1891	21.50	------	.61	------	------	------	------
1753	Paso Robles	1892	22.00	------	.34	------	------	------	------
1897	Paso Robles	1893	23.70	23.61	.44	.37	.150	.56	.53
1878	Amador station	1893	18.20	------	.78	.33	------	.67	------
2181	Amador station	1894	23.90	23.13	.54	------	.089	------	------
	Average, Cupertino	------	**24.42**	------	**.68**	------	**.225**	**.60**	**.51**
	Average, Mission San Jose	------	**22.39**	**21.59**	**.73**	**.31**	**.162**	**.72**	**.53**
	Average, Tulare	------	**22.74**	**21.49**	**.53**	**.44**	**.098**	**.50**	**.49**
	Average, Paso Robles	------	**22.10**	**23.61**	**.46**	**.37**	**.150**	**.56**	**.53**
	Average, Amador station	------	**21.05**	**23.13**	**.66**	**.33**	**.089**	**.67**	------

Summary of Analyses of Musts and Wines of Port Type—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.*		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric.	Ash	Tannin	Acid at Pressing.	Acid at Six Months
	Tinta Câo.								
1371	Cupertino	1890	23.25	------	.52	------	------	------	------
2051	Cupertino	1893	24.60	------	.72	------	.246	------	------
1379	Mission San José	1890	23.07	------	1.03	.23	.222	------	.42
1568	Mission San José	1891	21.10	------	.78	------	.210	.75	.50
1769	Mission San José	1892	22.80	21.80	.97	------	.120	.82	.60
2275	Mission San José	1894	20.20	------	.71	------	.166	.65	------
1467	Fresno	1891	22.40	21.80	.55	.60	.095	------	.18
1546	Paso Robles	1891	22.70	------	.38	------	------	------	------
1732	Paso Robles	1892	23.50	------	.50	------	------	------	------
1920	Paso Robles	1893	24.60	23.61	.56	.34	.100	.52	.69
1697	Tulare	1892	22.40	------	.45	------	------	------	------
1975	Tulare	1893	22.60	------	.71	------	.413	.69	------
2338	Tulare	1894	26.50	------	.40	------	------	------	------
1849	Amador station	1893	20.60	19.41	.79	.30	------	.55	------
2167	Amador station	1894	25.40	23.61	.48	------	------	.48	------
	Average, Cupertino	------	**23.92**	------	**.62**	------	**.246**	------	------
	Average, Mission San Jose	------	**21.79**	**21.80**	**.80**	**.23**	**.180**	**.74**	**.51**
	Average, Paso Robles	------	**23.60**	**23.61**	**.48**	**.34**	**.100**	**.52**	**.69**
	Average, Tulare	------	**23.83**	------	**.52**	------	**.413**	**.69**	------
	Average, Amador station	------	**23.00**	**21.51**	**.63**	**.30**	------	**.52**	------
	Mourisco preto.								
1674	Tulare	1892	22.40	22.67	.32	.39	.083	.41	------
1968	Tulare	1893	23.90	23.13	.47	.56	.066	.45	.49
2321	Tulare	1894	25.00	------	.54	------	------	------	------
1923	Paso Robles	1893	25.40	24.12	.47	.42	------	.50	.41
2185	Amador station	1894	25.20	------	.44	------	------	------	------
	Average, Tulare	------	**23.76**	**22.90**	**.44**	**.47**	------	------	------
	Mission.								
1720	Paso Robles	1892	23.25	23.13	.42	------	------	.37	------
1692	Tulare	1892	25.90	------	.38	------	------	------	------
1978	Tulare	1893	26.30	25.53	.38	.57	------	.39	.42
1256	Amador station	1890	22.20	------	.44	.31	.168	.40	.38
1870	Amador station	1893	20.40	------	.48	------	.154	.68	------
	Average, Tulare	------	**26.10**	**25.53**	**.38**	**.57**	**.074**	**.43**	**.49**
	Average, Amador station	------	**21.30**	------	**.46**	**.31**	------	------	------
	Aleatico.								
1368	Cupertino	1890	29.40	------	.74	------	------	------	------
2133	Cupertino	1893	30.00	------	.62	------	.266	------	------
1548	Paso Robles	1891	24.70	------	.44	------	------	------	------
1724	Paso Robles	1892	25.75	------	.50	------	------	------	------
1933	Paso Robles	1893	26.60	26.31	.53	.31	.311	------	------
1631	Tulare	1892	27.80	27.13	.41	.48	------	.42	.52
1796	Tulare	1893	24.35	23.13	.75	.30	------	.54	------
2148	Tulare	1894	24.40	------	.60	------	------	------	------
1851	Amador station	1893	22.20	20.99	.63	.26	.125	.59	.62
	Average, Cupertino	------	**29.70**	------	**.68**	------	**.266**	------	------
	Average, Paso Robles	------	**25.68**	**26.31**	**.49**	**.31**	**.311**	------	------
	Average, Tulare	------	**25.51**	**25.13**	**.58**	**.39**	------	**.48**	**.52**
	Moscatello fino.								
1310	Cupertino	1890	21.70	------	.63	.24	------	------	------
1919	Tulare	1893	23.30	------	.53	.40	------	------	------

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* Fortified.

SHERRY TYPE.

It is perhaps incorrect to speak of "California Sherries," for little or no wine of the true Sherry type is made in California. The celebrated wines of Jerez, except for limited quantities of "vinos dulces," are almost or quite dry, and made by processes essentially different from those practiced in California. The finest Spanish Sherries are fortified to a very limited extent, and contain only from 13% to 15% of alcohol after fortifying. They are made from very ripe or slightly dried grapes, which are crushed, fermented for two or three months, and racked before the addition of alcohol. Often a little "vino dulce," or sweet wine, is added later—enough to destroy any harshness, but not enough to cause the wine to be classed properly as "sweet." Sherries, so called, as made in California, are, on the contrary, always sweet and in general *very* sweet. They would more properly be called Sweet Madeira, the type to which they most closely approach. They are, in fact, what the French call sweet "vins de liqueur," of which an almost infinite variety is made in various vine-growing parts of the world. All these "vins de liqueur," though exhibiting a wonderful variety of qualities, have certain characteristics in common. They all possess low acidity, have more or less of a peculiar taste known as the "rancio," "gout de rance," and sometimes improperly as the "Sherry taste," and generally contain a certain quantity of unfermented sugar and a high percentage of alcohol.

The cause of this "rancio" taste has been the subject of much controversy and experiment. The tendency to impute all changes in wine to the action of some micro-organism led to the belief that the action of some ferment was responsible for the production of this taste in wines. It has now, however, been conclusively proved that it is due simply to chemical oxidation of the sugar and other organic constituents of the wine, without the presence, necessarily, of any living organism. Wines and syrups have been caused to acquire the "rancio" taste while being kept perfectly sterilized by the most careful precautions. It is, therefore, incorrect to call this the "Sherry taste," as it is common to many wines besides those of Jerez. The characteristic flavors of these, which could properly be called the "Sherry taste," are due to peculiarities of soil, variety of grape, and processes of manufacture, and can only be approximated outside of the Jerez district, while the "rancio" taste can be given to almost any wine in any locality by appropriate methods.

For the production of good "vin de liqueur" two qualities are essential in the grapes: they must be high in sugar and very low in acid. These conditions are constantly possible only in hot localities and with certain varieties of grapes. The great valley of California and the Sierra foothills are especially adapted to the production of these wines, and with proper varieties (the grapes of Andalusia, especially) excellent results can be and have been obtained. For the best results the must should show at least 24% of solid contents by spindle, and should not exceed 4 pro mille of acid. With the right varieties and proper treatment of the vines these conditions can perhaps always be fulfilled over a large part of California, without the trouble and expense of resorting to the European practice of exposing the gathered grapes to a partial evaporation in the sun before crushing. For the production of the commoner grades the addition of de-acidified grape syrup is the simplest and best method of increasing the sugar contents to the requisite standard. The fermentation should be carefully watched, in order that the wine may be racked and fortified with the desired amount of sugar, and before any danger of secondary fermentation arises. The oxidation and the acquirement of "rancio" are governed by time, temperature, and access of air. The higher the temperature and the fuller the access of air, the more rapidly does the wine acquire this taste. Within certain limits, however, the slower the oxidation the more delicate the resulting flavors. The common practice of heating the wine to a very high temperature for a short time cannot produce high-class wines. The best method is to mature the wine in a warm cellar, or heat for several months at a temperature not exceeding 100° F.

The Palomino, Pedro Jimenes, Perruno, Mourisco branco, and Mantuo de Pilas have all grown well, given good crops, and produced good wine in the lower San Joaquin Valley. They are much improved, however, by an addition of Verdelho or Boal, which bear much less, but possess higher quality and more pronounced flavor. A mixture, therefore, of two thirds of one or two varieties of the former group, with one third of Verdelho or Boal seems at present to be the best choice of varieties that can be made in that district for the production of sweet wines. Grenache and Mission have also given good results where they do not attain too much color, and could doubtless be well used to blend with the others, especially with the addition of a little Verdelho.

The Malmsey is also very promising as a variety to be used in small quantities to give character. It has a delicate aroma—that of the true Malvoisies—resembling Muscat, but more delicate and more suitable for sweet wines.

The Doradillo, one of the most esteemed grapes of Malaga and Granada, has been tried to a limited extent at the Eisen vineyard at Fresno, and has proved a strong grower and heavy bearer. It has apparently all the requisites for the making of a good sweet wine, but has not yet been thoroughly tested.

The Furmint, or true Tokay grape, has been tried at the same vineyard, and has produced some good wine, but it would probably give better results in the foothills.

The only varieties which seem at all promising for the production of sweet wines in the cooler localities are the Palomino and the Verdelho. These varieties make an excellent blend, but as the Palomino ripens later than the Verdelho, the blending should be done at the first racking. Whether dry wines of the true Jerez type can be produced in California cannot be definitely settled without considerable further experiment.

PEDRO JIMENES.

(See Vit. Rept. 1883–85, p. 130; 1885–86, p. 105.)

Synonyms: Pero Ximenes; Pedro Ximenez.

The Pedro Jimenes is the principal wine-grape of Malaga, Granada, and Motril; it is also cultivated to a more limited extent in Jerez and Pajarete. It is chiefly famous as the grape from which the widely known Pero Jimenes wine is made. It is also used in conjunction with the Palomino in the manufacture of dry Sherries, and occasionally with the Tintas for the manufacture of red wines. It has been introduced with great success into the Crimea and Algeria, and less successfully into the south of France. Clemente describes and figures two varieties under this name, one of which he calls the typical Pedro Ximenez, and the other the Ximenez Zumbon. They differ considerably in size of berries and fertility of the vines, but are, according to Mas and Pulliat, simple variations obtained by selection of cuttings.

Description.—Vine vigorous and productive, with slender, short-jointed canes; leaves of medium size, with shallow, narrow sinuses, teeth blunt and short, upper surface glabrous, the lower surface at first covered with a little close wool, becoming glabrous, veins light yellow; bunches very large, branching, loose, but well filled, berries very large, slightly oval, firm, fleshy, and of golden-yellow color.

The above description is taken from vines as they are growing at the Experiment Stations, and differs in several respects from the description of this variety in European works. The grapes as they grow here are much larger, ripen later, and do not attain the extremely high sugar contents with which the Pedro Jimenes is credited in Andalusia. It is somewhat doubtful, therefore, if we have the real Pedro Jimenes here, but a new importation made by the Agricultural Experiment Station this year will probably settle the question. The average must composition of this variety has been: at Mission San José and Cupertino, 21.8% of sugar and 0.42% of acid; at Fresno and Tulare, 22.7% of sugar and 0.38% of acid; at Paso Robles, 21.5% of sugar and 0.45% of acid. The figures for Amador are not given, as the grapes were gathered there before they were mature. These figures show that this variety fails to attain as large an amount of sugar as the Palomino, and shows a little more acid. It ripens late, and is certainly not to be recommended for the cooler localities. In the hotter valleys it has so far not equaled the Palomino either in chemical composition or in quality, and for the making of Sherries cannot at present be said to have shown any advantages over that variety. It makes a neutral, dry wine, of very light body, which may be useful in blending and for the manufacture of champagne wines.

It may find a place as a table-grape, as its magnificent bunches and berries are not exceeded in beauty by any white variety, and their firmness makes it more suitable for shipping purposes than the Verdal. The vine requires a rich soil and short-pruning to maintain its fertility. As a variety for dry white wine the Pedro Jimenes has shown some good qualities at Tulare. It requires, however, the addition of some variety of higher aroma, such as the Malmsey (see No. 1900), and would also be improved by the addition of a more acid grape for this purpose.

It will be seen by the above account that the character of this grape, and of the wine made from it, is so different from what it is credited with in Spain that the discrepancy can hardly be accounted for by simple difference of conditions.

TABLE OF PRODUCTION.

PEDRO JIMENES.	Number of Vines	Total Weight of Grapes, in lbs.	Average per Vine, in lbs.	Date of Picking
1887—No. 784 (long-pruned). J. T. Doyle, Cupertino	20	146	7.3	Oct. 27
1888—No. 953 (long-pruned). J. T. Doyle, Cupertino	19	140	7.3	Nov. 6
1889—No. 1191. J. T. Doyle, Cupertino	16	120	7.5	Oct. 17

ANALYSES OF MUSTS AND WINES.

PEDRO JIMENES.	Date of Picking	MUST.				WINE.						
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six to Eight Months	Volatile Acid	Body	Ash	Sugar
						By Weight	By Volume					
1884—No. 266. Natoma Wine Co., Natoma	......	20.78	20.61	.33	.40	9.63	12.00	.56	......	1.18	.39	......
1886—No. 484. Natoma Wine Co., Natoma	Sept. 20	19.30	18.89	.38	.35	7.78	9.73	.59	......	2.00	......	......
1887—No. 784. J. T. Doyle, Cupertino	Oct. 27	21.26	20.61	.45	.40	7.50	9.36	.68	.23	2.30	......	......
1888—No. 953. J. T. Doyle, Cupertino	Nov. 6	19.40	19.89	.35	.48	7.64	9.54	.36	......	2.40	......	......
1889—No. 1191. J. T. Doyle, Cupertino	Oct. 17	20.06	......	.25	.41	14.33*	17.70*	.21	......	4.00	......	......
1890—No. 1244. Margherita Vineyard, Fresno	Aug. 23	21.20	20.39	.41	.61	16.31*	20.06*	.30	......	2.77	......	5.15
No. 1352. J. Gallegos, Mission San José	Oct. 12	22.30	......	.42	......	14.08*	17.40*	.34	......	2.48	......	2.60
No. 1404. J. T. Doyle, Cupertino	Oct. 20	19.70	......	.47	.23	13.92*	17.20*	.33	......	2.08	......	traces
1891—No. 1502. Fresno	Sept. 22	23.70	23.13	.45	......	15.50*	19.08*	.30	......	2.61	......	1.74
No. 1502*a*. Fresno	Sept. 22	23.70	23.13	.45	......	16.31*	20.06*	.27	......	......	......	......
No. 1606. Mission San José	Oct. 25	24.80	......	.49	.37	17.25*	21.19*	.20	......	3.31	......	.64
1892—No. 1670. Tulare	Sept. 17	22.60	21.38	.33	.47	14.82*	18.25*	.38	......	2.55	......	1.75
No. 1779. Mission San José	Oct. 13	23.15	22.67	.50	......	9.27	11.55	.53	......	2.60	......	......
1893—No. 1853. Amador station	Sept. 13	19.30	......	.53	......	......	......	......	......	......	......	......
No. 1900. Tulare	Sept. 27	22.20	21.80	.41	.43	8.48†	10.58†	.45	......	2.60	......	......
No. 1916. Paso Robles	Oct. 5	21.50	21.00	.40	.38	......	18.25*	.35	......	2.85	......	......
No. 2036. Cupertino	Oct. 30	23.70	......	.47	......	......	......	......	......	......	......	......
1894—No. 2164. Amador station	Sept. 17	21.50	......	.58	......	......	......	......	......	......	......	......
No. 2214. Paso Robles	Sept. 26	21.50	......	.49	......	......	......	......	......	......	......	......
No. 2246. Mission San José	Oct. 3	22.30	......	.42	......	......	......	......	......	......	......	......
No. 2350. Tulare	Oct. 27	23.90	......	.29	......	......	......	......	......	......	......	......

* Fortified. † Blend with No. 1901 (Malmsey).

Record of Treatment.

No. 784. *Pedro Jimenes*, from Cupertino. Received October 28, 1887, in good condition, and crushed on the same day. A few bunches were compact, but they were generally loose and characteristically branched; the berries were large, sound, sweet, and with very little acid, a few were prematurely dried, and there was some coulure. The must showed 21.26% of solid contents by spindle and 0.45% of acid. The temperature of the grapes at crushing was 72°, and the maximum reached was 88°, on the second day. The yield of wine was 8.7 gals., being at the rate of 170 gals. per ton.

At two weeks, when the wine was racked, the odor was not good. A month later it was still cloudy, and had a flat and suspicious taste. An examination of the lees showed the presence of acetic ferment and some filaments. The wine was therefore racked and pasteurized. After this the wine did not improve, but continued to deteriorate until, at fourteen months, it was distilled.

No. 953. *Pedro Jimenes*, from Cupertino. Received November 8, 1888, in good condition. The bunches showed signs of coulure, and the berries were deficient in both acid and sugar. The 98.5 lbs. crushed yielded 7.8 gals. of wine, or at the rate of 160 gals. per ton. The temperature of the grapes at crushing was 67°, and the maximum reached was 84°, on the second day. The wine was dry on the eleventh day.

At two weeks the wine was drawn off, and two weeks later it was taken to the cellar. At two months it was clear and with fair aroma, but too low in alcohol and with a green taste. Two months later it was racked again and the lees examined. At nine months the wine was bright and had improved in bouquet and flavor; it tasted quite sound, and had developed rapidly. At thirteen months it was in good order, but some bottled at four months had not kept well. At fifteen months the lees were sound, and the wine was bright, and had developed a strong Sherry bouquet and flavor. Five months later it was still in good order, but the aroma had diminished and the wine tasted a little thin; the lees were quite sound, and a month later the wine was bottled. At two years and four months the wine bottled at four months was spoiled, but that bottled at twenty-one months was bright, delicately flavored and clean-tasting, but rather thin. At four years it had changed little, and was still bright and sound. At seven years it had deteriorated and tasted mousy.

No. 1191. *Pedro Jimenes*, from Cupertino. Received October 18, 1889, in fairly good condition, and was crushed on the same day. The grapes were extremely fine in appearance, the bunches very large and well filled with very large berries; they were, however, rather low in sugar. The must showed 20.06% of solid contents by spindle and 0.25% of acid. The 56 lbs. crushed yielded at the rate of 161 gals. per ton. The temperature of the grapes at crushing was 69°, and the maximum reached was 75°, on the third day. On the third day the fermentation was checked by the addition of a small quantity of spirits, and on the fifth day the fortifying was completed.

At three months the wine was clear, but was thin and insipid; only in the faint bouquet was there any suggestion of the high quality which the variety ought to show. Three days later it was racked and sweetened by the addition of rock-candy. At four months it was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At seven months it was bright, clean-tasting, and much improved. It was racked again, and four months later showed little change. At twenty months it was bright, with pleasing but not marked flavor, of fair quality, but lacking in body and character. Eight months later it showed considerable improvement. At six years and four months it was in good condition, was smooth, agreeable, and mature, but with little aroma or flavor.

No. 1244. *Pedro Jimenes*, from Fresno. Received August 26, 1890, in good condition, but not quite mature. The must showed 21.2% of solid contents by spindle and 0.41% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 83°, on the third day. On the third day the wine was fortified.

At three months the wine was nearly clear, with less aroma and flavor than the Palomino from Fresno, but still very pleasing. The acidity was low, but there was too much sweetness. Two months later it was bright, with good, delicate aroma, less pronounced than the Palomino, but more delicate. The wine was racked, and put in the heating-chamber, at a temperature of 110°, for three months. At ten months it was in good order, with good Sherry aroma and flavor, but not of marked character. It was racked for the third time, and at seventeen months it was bright, clean-tasting, and agreeable, but too sweet. It was racked again, and at three years and ten months was still in good order. Four months later it was nearly mature, and was a good wine but for an excess of sweetness and a slight bitterness; it was put in glass. At five years and five months it was a good, clean-tasting Sherry, with rather more bouquet than the Palomino, but less marked "rancio" taste.

No. 1352. *Pedro Jimenes*, from Mission San José. Received October 14, 1890, in fair condition. The must showed 22.3% of solid contents by spindle and 0.42% of acid. The temperature of the grapes at crushing was 66°, and the maximum of 82° was reached on the third day. On the fourth day the wine was fortified while still a little sweet.

At three months the wine was bright, with faint aroma and fair flavor, rather too light, and the alcohol not well blended. A week later it was racked and put in the heating-chamber, at a temperature of 110°, for three months. At eight months it was bright and much improved in bouquet and flavor, clean-tasting, fruity, and well flavored. At this date it was racked. At sixteen months it was in very good condition, with good bouquet and flavor, rather low-bodied, but otherwise a good Sherry. After this the wine did not keep well, on account of the smallness of the keg.

No. 1404. *Pedro Jimenes*, from Cupertino. Received October 23, 1890, in good condition, but not quite mature. The ripening was irregular. The must showed 19.7% of solid contents by spindle and 0.47% of acid. The temperature at crushing was 66°, and the maximum reached was 82°, on the third day. It was fortified on the third day while still sweet.

At three months the wine was bright, but thin and vapid. It was racked, and two months later refortified. At seven months it was put in the heating-chamber, at a temperature of 105°, for three months. After this it did not improve, but remained a poor wine without quality. It was thin, flavorless, and unpleasing.

No. 1502. *Pedro Jimenes*, from Fresno. Received September 25, 1891, in good condition. The must showed 23.7% of solid contents by spindle and 0.45% of acid. The temperature of the must at crushing was 70°, and the maximum reached was 75°, on the third day. The fermentation was slow, and on the seventh day, when the wine was fortified, it was still sweet. Half of the must was used for a special fermentation, as follows: On the second day the must was fortified to 6% of alcohol; on the third day the maximum temperature of 78° was reached; on the fourth day 1% of alcohol was added. The fermentation continued slowly for fifteen days, when the fortifying was completed.

No. 1502 (ordinary fermentation). At four months the wine was full-flavored and rather too sweet. A month later it was racked for the second time, and at six months was put in the heating-chamber, at a temperature of from 90° to 95°. At two years and ten months it differed little from No. 1502*a*, but was, if anything, not quite so good. Four months later, when it was bottled, it was a little too sweet. At four years and five months the wine was clean-tasting, neutral, still immature, but promising.

No. 1502*a* (special fermentation). At four months the wine was bright, full-flavored, and of medium sweetness. A month later it was racked, and at six months was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years and ten months it was a very agreeable Sherry, with good bouquet and flavor of distinctive Sherry character, but not quite perfect in after-taste. Four months later it was bottled; it was very good, but had a slight bitterness. At four years and five months it differed little from No. 1502.

No. 1606. *Pedro Jimenes*, from Mission San José. Received October 28, 1891, in poor condition, many grapes being moldy. The temperature of the grapes at crushing was 68°, and the maximum reached was 81°, on the third day. The must showed 24.8% of solid contents by spindle and 0.49% of acid. The wine was fortified on the fourth day.

At three months the wine was clear, with full sweetness, but not much flavor. A month later it was racked, and at five months was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years and nine months it was bright, of good, clean taste, agreeable aroma and flavor, but little Sherry character. Four months later it had improved, and was put in glass. At four years and four months it was a fair Sherry, with good flavor, but not mature, and lacking in delicacy of aroma.

No. 1670. *Pedro Jimenes*, from Tulare station. Received September 19, 1892, in good condition, and of good quality. The must showed 22.6% of solid contents by spindle and 0.33% of acid. The temperature of the grapes at crushing was 65°, and the maximum reached was 77°, on the fourth day. The wine was fortified on the sixth day while still a little sweet.

The wine was clear at three weeks, and was racked. At three months it was bright and well flavored, but too dry. It was racked again, and at six months was refortified and sweetened. At thirteen months it was racked again, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years it was in good order, with full flavor and aroma, good body, sufficient sweetness and alcohol, altogether an agreeable Sherry, and maturing quickly. At three years and five months it was a very good Sherry, of clean taste, full aroma, and nearly mature.

No. 1779. *Pedro Jimenes*, from Mission San José. Received October 16, 1892, in good condition. The must showed 23.15% of solid contents by spindle and 0.50% of acid. The temperature of the grapes at crushing was 62°, and the maximum reached was 80°, on the third day. On the sixth day the wine was nearly dry, and on the seventh day it was racked off the thick lees.

In three weeks the wine was clear and perfectly dry. At one month it was racked and taken to the cellar. At three months it was bright, with some aroma, good flavor, medium acid, and good body; in general, very agreeable. Two months later it was in perfect condition, and was a good, clean-tasting wine. It was racked for the third time, and at eight months it had retained its good quality and was superior to No. 1780, Palomino. Tastings at ten and fourteen months showed gradual development and the acquirement of some bouquet. At fifteen months it was bottled. Two years after bottling it had made no deposit in the bottles, and was a good, neutral, clean-tasting wine, somewhat lacking in bouquet, but fully mature.

No. 1853. *Pedro Jimenes*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition. The bunches were large and loose; the berries of good size, not mature. The must showed 19.3% of solid contents by spindle and 0.53% of acid.

No. 1900. *Pedro Jimenes*, from Tulare station. Received September 29, 1893, in good condition, but not quite mature. The bunches and berries were both large, and of very fine appearance. The must showed 22.2% of solid contents by spindle and 0.41% of acid. The grapes were mixed with No. 1901, Malmsey, from Tulare, in the proportion of 50 lbs. of the former to 72 lbs. of the latter. The temperature of the grapes at crushing was 66°, and the maximum reached was 78°, on the third day.

The wine was nearly dry on the fourth day. At one month it was clear, of good aroma and pleasing flavor, and was racked and taken to the cellar. At four months it was in good condition, with marked aroma and good body. A month later it was racked for the second time, and at seven months it was a wine of good character, fresh-tasting and pleasant. At eleven months it had developed well and retained its good qualities. At twelve months it was one of the best of the Tulare wines. At seventeen months it had changed little and was nearly mature. Three months later it was bottled. At two years and five months it was bright and without deposit in the bottles. It was very fresh and clean-tasting, and had developed a good bouquet. The Malmsey had given it a slight Muscat aroma.

No. 1916. *Pedro Jimenes*, from Paso Robles station. Received October 7, 1893, in good condition. The bunches were large, irregular, and loose; the berries over average in size, slightly oval and crisp. The grapes were quite mature. The must showed 21.5% of solid contents by spindle and 0.40% of acid. The temperature of the grapes at crushing was 68°, and the maximum reached was 78°, on the third day. On the seventh day the wine was fortified while still sweet.

At two months the wine was bright, but flat and too dry. At eight months it was racked for the second time, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At eleven months it was racked again. At fourteen months it was in good order and much improved; its flavor and aroma were good, but it was too alcoholic. At two years and four months it was bright, still raw, but full flavored, clean-tasting, and promising.

No. 2036. *Pedro Jimenes*, from Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were very large, conical, winged, loose; the berries varying from very large to very small in the same bunch, crisp, juicy, very sweet, and quite mature. The must showed 23.7% of solid contents by spindle and 0.47% of acid.

PALOMINO.

(See Vit. Rept. 1883–85, p. 131; 1885–86, p. 105.)

Synonyms: Listan; Temprano; Tempranilla; Golden Chasselas (California).

It is from this variety that the bulk of the Manzanillas and dry export Sherries of southwestern Spain are made. It is also used extensively in Malaga, both for wine-making and for the table. In Granada and other parts of southern Spain it is planted chiefly as a table-grape, for which purpose it is much esteemed. It is also used to a more limited extent for the production of the sweeter wines of Cadiz, but generally in connection with Pedro Jimenez or some other variety.

Description.—Vigorous in all fairly productive soils; leaves medium to large, five-lobed, upper sinuses wide at the base and often closed above, upper surface loose, woolly when young, soon becoming glabrous, lower surface densely and permanently white-woolly; bunches medium to large, irregular, loose; berries large, round, or flattened vertically, crisp, and fleshy.

The Palomino has established itself as a valuable grape for some parts of California. It has been used for the production of dry wine in some of the cooler localities, but not with great success. It is a good and regular bearer, but the wine in such localities is lacking in freshness and quality. The chemical composition of the must shows it to retain its European characteristics in California, and that it is essentially a Sherry or sweet-wine grape. It attains a high percentage of sugar even in the coast counties, is very regular in its ripening, and never exhibits excess of acid. The average composition of the must at Mission San

José and at Cupertino has been 22.6% of sugar and 0.41% of acid; at Fresno and Tulare, 23.9% of sugar and 0.29% of acid; at Paso Robles, 21.3% of sugar and 0.39% of acid; at Amador, 23.0% of sugar and 0.43% of acid. It cannot, therefore, be recommended for the production of light or dry wines in any locality, on account of its lack of acid and freshness. Of all the true Sherry grapes, however, it is the one which is most suited to the cooler localities. It ripens earlier and more regularly than the Pedro Jimenes and Mantuo, and makes a good, sweet Sherry, even in the coast counties. It has a distinctive natural aroma, which is lacking in most of the other Sherry grapes, but which decreases with age. As a grape for sweet wine or Sherry, it can be well recommended for any except the very late localities and those where the soil is too poor.

TABLE OF PRODUCTION.

PALOMINO.	Number of Vines	Total Weight of Grapes, in lbs.	Average per Vine, in lbs.	Date of Picking
1887—No. 765 (long-pruned). J. T. Doyle, Cupertino	20	106	5.3	Oct. 20
No. 698 (long-pruned). J. T. Doyle, Cupertino	20	378	18.9	Oct. 5
No. 728 (short-pruned). J. T. Doyle, Cupertino	20	232	11.6	Oct. 13
1888—No. 951. J. T. Doyle, Cupertino	18	218	12.1	Nov. 5
No. 952. J. T. Doyle, Cupertino	20	370	18.5	Nov. 5
1889—No. 1198. J. T. Doyle, Cupertino	16	175	10.9	Oct. 24

ANALYSES OF MUSTS AND WINES.

PALOMINO.	Date of Picking	MUST.				WINE.						
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six Months	Volatile Acid at Six Months	Body	Ash	Sugar
						By Weight	By Volume					
1884—No. 267. Natoma Wine Company, Natoma	------	23.86	23.81	.32	.40	11.08	13.50	.53	------	1.85	.25	------
1885—No. 384.† L. D. Combe, San José	------	------	------	------	------	10.54	13.00	.57	------	2.18	.25	------
1886—No. 547. E. W. Hilgard, Mission San José	------	23.70	------	.55	------	------	------	------	------	------	------	------
No. 504. J. T. Doyle, Cupertino	Sept. 27	16.30	15.68	.53	.27	6.35	8.00	.59	------	1.55	------	------
1887—No. 727 (long-pruned). E. W. Hilgard, Mission San José	Oct. 10	22.00	20.85	.35	.40	8.91	11.09	.47	.02	2.40	------	------
No. 765 (long-pruned). J. T. Doyle, Cupertino	Oct. 20	23.09	22.67	.42	.44	9.78	12.18	.44	.05	2.60	------	------
No. 698 (long-pruned). J. T. Doyle, Cupertino	Oct. 5	19.57	19.75	.37	.38	7.50	9.36	.49	.06	2.10	------	------
No. 728 (short-pruned). J. T. Doyle, Cupertino	Oct. 13	23.30	22.67	.47	.37	9.70	12.09	.47	.05	2.60	------	------
No. 683. R. Wegener, Livermore	Sept. 13	22.60	22.58	.38	.40	9.12	11.36	.47	.05	2.40	------	------
1888—No. 952. J. T. Doyle, Cupertino	Nov. 5	21.57	22.67	.18	.36	8.77	10.91	.52	------	2.05	------	------
No. 951. J. T. Doyle, Cupertino	Nov. 5	21.39	21.80	.24	.34	8.27	10.36	.42	------	2.30	------	------
1889—No. 1041. Margherita Vineyard, Fresno	Sept. 2	25.00	25.19	.18	.65	*13.92	17.20	.44	------	2.35	------	5.20
No. 1171. J. Gallegos, Mission San José	Oct. 15	23.05	23.13	.38	.33	*15.58	19.00	.32	------	3.01	------	------
No. 1198. J. T. Doyle, Cupertino	Oct. 24	23.70	23.13	.22	.42	9.05	11.27	.39	------	1.95	------	------
1890—No. 1239. Margherita Vineyard, Fresno	Aug. 23	23.92	23.42	.34	.33	*14.82	18.25	.25	------	2.48	------	9.00
No. 1311. J. T. Doyle, Cupertino	Oct. 7	20.85	------	.43	.27	9.41	11.73	.38	------	2.10	------	------
No. 1397. J. T. Doyle, Cupertino	Oct. 18	24.60	------	.31	------	------	------	------	------	------	------	------
No. 1423. J. Gallegos, Mission San José	Oct. 31	28.00	------	.34	------	------	------	------	------	------	------	------
1891—No. 1476. Fresno	Aug. 28	24.10	23.62	.36	.48	*16.31	20.00	.11	------	2.45	------	1.50
No. 1519. Mission San José	Sept. 30	25.45	------	.53	------	------	------	------	------	------	------	------
1892—No. 1654. Paso Robles	Sept. 13	21.30	20.21	.39	.31	*15.67	19.28	.38	------	2.55	------	1.40
No. 1671. Tulare	Sept. 17	23.70	22.67	.32	.48	*15.42	18.98	.37	------	2.55	------	1.25
No. 1780. Mission San José	Oct. 13	20.50	19.75	.55	------	8.00	10.25	.59	------	2.55	------	------
1893—No. 1843.‡ Tulare	Sept. 10	21.95	20.24	.38	.52	*14.75	18.88	.32	------	4.00	------	1.39
No. 1875.‡ Amador station	Sept. 12	20.60	------	.47	------	------	------	------	------	------	------	------
No. 1979. Tulare	Oct. 16	23.70	22.23	.26	.39	------	------	------	------	------	------	------
No. 2019. Mission San José	Oct. 26	22.90	21.38	.61	.35	*13.81	17.70	.48	------	4.30	------	1.83
No. 2067. J. T. Doyle, Cupertino	Oct. 31	24.80	------	.47	------	------	------	------	------	------	------	------
1894—No. 2154. Tulare	Sept. 15	24.00	------	.28	------	------	------	------	------	------	------	------
No. 2165. Amador station	Sept. 17	24.05	22.67	.44	------	------	------	------	------	------	------	------
No. 2166. Amador station	Sept. 17	24.40	23.13	.38	------	------	------	------	------	------	------	------
No. 2251. Mission San José	Oct. 3	22.40	------	.41	------	------	------	------	------	------	------	------
No. 2292. Tulare	Oct. 10	24.60	24.01	.26	------	------	------	------	------	------	------	------

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* Fortified. † Wine sent for examination. ‡ "Golden Chasselas."

Record of Treatment.

No. 683. *Palomino*, from R. Wegener, Livermore. The grapes arrived September 16, 1887, and were worked the following day. Their condition was good, so far as transportation was concerned, but many of the berries were half-dried and some rotten and fermenting. They were picked over before crushing. The bunches were very characteristic, large, loose, with many pendent branches; there was very little coulure; the berries were, on the average, small, but very unequal, strictly globular, bronzed on the exposed side, thick-skinned, sweet, and low in acid. The must showed 22.6% of solid contents by spindle and 0.38% of acid. The must from 80 lbs. was crushed, and reached a maximum temperature of 81° on the third day. The grapes yielded juice at the rate of 150 gals. per ton.

Ten days after crushing the wine was drawn off from the thick lees, and at three months was bright, with some aroma, sound and agreeable. It was racked for the second time at four months; and at eight months, the lees showing some unsound germs, it was racked again and pasteurized. Six weeks later it was clear and had developed some bouquet; the acid was moderate, but slightly sharp. At sixteen months the wine was distilled for brandy.

No. 698. *Palomino*, from Cupertino. The grapes were received October 6, 1887, and crushed the following day. They were in good condition; the bunches large and compact, the berries generally large, but some small and deeply colored; there was little coulure. The must showed 19.57% of solid contents by spindle and 0.37% of acid. The maximum temperature reached during fermentation was 85°, on the third day. The 113 lbs. of grapes crushed yielded must at the rate of 158 gals. per ton.

In three weeks the wine was drawn off from the thick lees. At two months it was clear, of good aroma, medium and agreeable acid, sound, and well advanced. At seven months the wine was racked and pasteurized for safety. At seven months it was a neutral wine of moderate acid and rather backward development. At fifteen months it was distilled for brandy.

No. 727. *Palomino*, from Mission San José. The grapes were received October 13, 1887, and worked the following day. They were in fair condition, but of very uneven degrees of development, being from vines of various ages. The berries were, on the average, 40% larger than those of No. 683, Palomino, from Livermore. Some of the berries were dried to raisins and some were sunburned. The must showed 22.0% of solid contents by spindle and 0.35% of acid. The fermentation reached its maximum on the third day at a temperature of 86°, and was finished on the thirteenth day. The yield from 98.8 lbs. crushed was at the rate of 120 gals. per ton.

Three weeks after crushing the wine was drawn off from the thick lees. Three weeks later it was still turbid, but showed good quality; the acid, however, was rather suspicious. An examination of the lees showed the presence of improper germs, so the wine was racked off and pasteurized. At eight months it was clear, much improved, a light wine with some bouquet. It was racked again, and at fifteen months was distilled for brandy.

No. 728. *Palomino*, from Cupertino. The grapes were received October 14, 1887, and crushed the same day. The lot was in excellent condition, and mature. The bunches were very large and fine, and showed very little coulure; one bunch weighed nearly 2 lbs. The berries were very large, and of good flavor. The must showed 23.3% of solid contents by spindle and 0.47% of acid. The 102.3 lbs. crushed yielded at the rate of 137 gals. per ton. The temperature of the grapes at crushing was 69.5°, and the maximum reached was 82°, on the third day.

Two weeks after crushing the wine was drawn off from the thick lees. At two months the wine was still cloudy, with good acid and some aroma. The lees showed some unsound ferments, so the wine was racked and pasteurized. At eight months the wine was clear, had developed some bouquet, but was not quite clean-tasting, and had less Sherry taste than No. 765. At this date it was racked again, and at fifteen months it was distilled for brandy.

No. 765. *Palomino*, from Cupertino. Received October 21, 1887, in fair condition. The bunches were large, but much coulured; the berries uneven in size, and on some bunches abortive and dried up before maturity. The must showed 23.09% of solid contents by spindle and 0.42% of acid. The 93 lbs. crushed yielded juice at the rate of 120.9 gals. per ton. The temperature of the grapes at crushing was 74°, and the maximum reached was 83°, on the second day.

At two months the wine was still a little cloudy; it had but little aroma, and had a suspicious taste. A microscopic examination of the lees showed unsound germs, so the wine was racked and pasteurized. At eight months it had improved very much, had developed some bouquet and a full Sherry taste, but was not quite clean-tasting. It was racked again, and at fifteen months distilled for alcohol.

No. 952. *Palomino*, from Cupertino. Received November 7, 1888, in excellent condition, and mature. The bunches were loose and the berries of good size. The must showed 21.57% of solid contents by spindle and 0.18% of acid. The 105 lbs., which were crushed on the day they arrived, yielded 7 gals. of wine, being at the rate of 133 gals. per ton. The temperature of the grapes at crushing was 70°, and the maximum reached was 84°, on the third day. The wine was dry on the twelfth day.

At three weeks the wine was racked and taken to the cellar. At three months it was not quite clear, but was sound and good, and had some flavor and bouquet. At five months the lees were sound, but at six months they showed some unsound germs, so the wine was pasteurized. Two months after pasteurizing it was racked; it was clear and tasted sound. At nine months it was bright, with marked and agreeable flavor, full acid, clean taste, and advanced development. At fourteen months the wine in the keg was in good condition. Some bottled at four months was sound, but tasted flat; some bottled at eight months was very good, but had less bouquet than that in the keg. At fifteen months the wine was mature, and was bottled; it was in good condition, and showed less character and more acid than No. 951, the imported Palomino. At two years and four months the bottled wines were tasted. That bottled at four months was spoiled. There was little difference between that bottled at eight months and that bottled at fifteen—both were bright, of agreeable, neutral flavor, little bouquet, and low body. After this the earlier bottled wines deteriorated. That bottled later improved for about a year, acquiring a "goût de rance," but after that deteriorated, and at seven years had contracted a "mousy" taste.

No. 1041. *Palomino*, from Fresno. Received September 5, 1889, in fair condition. The bunches were of medium size, very ripe, but not dried. They were crushed on the day they arrived, and yielded at the rate of 146 gals. per ton. The temperature of the grapes at crushing was 70°, and the maximum reached was 84°, on the fourth day. On the sixth day the wine had fermented sufficiently, and was fortified.

At four months the wine was clear and of agreeable aroma and flavor, with rather too much acid, but giving promise of good quality. It was racked, and, being too dry, was sweetened by the addition of a small quantity of rock-candy. A month later it was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At nine months it was racked for the third time; it was bright, of good amber color, and good quality. At thirteen months it was in good condition, and showed much improvement in bouquet and flavor. At twenty-two months it was clear, full-flavored, and well developed. At six years it was in good order, and mature. It was a very smooth, clean-tasting, sweet Sherry, full-flavored, and with some bouquet.

No. 1171. *Palomino*, from Mission San José. Received October 16, 1889, in good condition, and mature. The grapes were crushed the same day, and yielded at the rate of 144 gals. per ton. The temperature of the grapes at crushing was 63.5°, and the maximum reached was 81°, on the third day. On the second day, when the temperature had risen to 77°, 0.25 gal. of spirits at 73% was added to the 3.6 gals. of must. On the third day 0.125 gal. was added, and on the seventh day the final addition of spirits was made.

At four months the wine was clear, clean-tasting, and agreeable, but without much character. A week later it was put in the heating-chamber, at a temperature of from 90° to 95°. At eight months it was racked for the second time; it was bright and showed much general improvement. Four months later it was in good condition and was getting on well. At twenty-one months it was bright and good, but slightly bitter. At two years and five months it had developed into a fair Sherry, but was still rather raw. Four years later it was in good condition, smooth and clean-tasting, with good Sherry flavor and more character than No. 1191, Pedro Jimenes, from Cupertino.

No. 1198. *Palomino*, from Cupertino. The grapes were received October 24, 1889, in fair condition, and mature. They were crushed the same day, and yielded at the rate of 160 gals. per ton. The must showed 23.7% of solid contents by spindle and 0.22% of acid. The temperature of the grapes at crushing was 68°, and the maximum reached was 76.5°, on the third day.

The wine was racked at two weeks, and at six weeks was bright, of agreeable flavor and aroma; it was racked and taken to the cellar, but after this it deteriorated, and at three months the odor was not good, the lees showed secondary ferments, and the wine had to be pasteurized. At ten months it had improved, was smooth and agreeable, but not quite clear, and was of inferior aroma. After this it deteriorated, and at sixteen months, though it was bright, it had suffered from the smallness of the keg and had to be put in glass. It changed little in glass for some time, but was evidently of such poor keeping quality that it was thrown away.

No. 1239. *Palomino* (Golden Chasselas), from Margherita Vineyard, Fresno. Received August 26, 1890, in good condition, and mature. The must showed 23.9% of solid contents by spindle. The fermentation continued for three days, at the end of which time the murk was fortified while still sweet. The maximum temperature reached was 82°.

At three months after crushing the wine was bright, possessed of a good aroma, full flavor, low acid, and too much sugar. At five months it was still in good order, but was too low in alcohol, and was therefore refortified. At seven months it was racked for the second time, and placed in the heating-chamber, at a temperature of 105°, where it was kept for three months. At seventeen months the wine was in first-class condition, had a good flavor, but had lost some of its aroma.

No. 1311. *Palomino* (Golden Chasselas), from J. T. Doyle, Cupertino. Received October 10, 1890, in fair condition; very fine grapes, but most of the bunches had a few rotten berries. The must showed 20.85% of solid contents by spindle. The fermentation was cool and somewhat prolonged, lasting over eight days.

At one month the wine was nearly clear, possessed of a marked aroma, agreeable flavor, and full, pleasing acid. At two months it was racked for the second time, and a month later, the lees showing some lactic germs and the taste beginning to be affected, it was pasteurized. At seven months it was clear and had improved, but still had a faint suspicion of lactic taint in the odor. At fourteen months the lactic ferment had quite disappeared, and the wine had some bouquet and full flavor; it was mature, or nearly so. Two months later the wine was in good condition, having been racked four times, and was bottled. At two years the bottled wine was clear, somewhat deficient in bouquet and freshness, but of good flavor and body.

No. 1397. *Palomino*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 21, 1890, in fair condition, and mature. The must showed 24.6% of solid contents by spindle.

No. 1423. *Palomino*, from Mission San José. A sample for must analysis arrived October 31, 1890, in fair condition; perfectly mature, and a few of the grapes dried up. The must showed 28.0% of solid contents by spindle.

No. 1476. *Palomino*, from Margherita Vineyard, Fresno. Received August 31, 1891, in good condition. The must showed 24.1% of solid contents by spindle and 0.36% of acid. The grapes were crushed the day of arrival, and the must divided into two lots, which were fermented separately.

No. 1476. The temperature of the must at crushing was 65°, and the maximum reached was 75°, on the third day. On the sixth day the wine was fortified. At four months it was bright, full-flavored, clean-tasting, and with very little sweetness. At five months it was racked for the second time, and a month later put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years and ten months it was in good condition, with full flavor and aroma, but slightly bitter. Four months later it showed the effect of being in so small a keg; the sweetness had increased very much by condensation, so the wine was put in glass. At four years and five months it was a full-flavored, agreeable Sherry, but tasted of the keg.

No. 1476*a*. The temperature of the grapes at crushing was 65°. The must was fortified to 5% of alcohol before the fermentation commenced. The maximum temperature reached was 73.5°, on the fourth day. On the eleventh day the wine was still fermenting a little, and as sufficient sugar had been eliminated, the spirits necessary to complete fortifying were added. At four months the wine was bright, full-flavored, and clean-tasting, with moderate sweetness; differed little from No. 1476. A month later it was racked, and at six months put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At fourteen months it was in good order, full-flavored, a rather good Sherry, with the peculiar Palomino flavor. The sweetness had increased considerably by evaporation. At this age it was put in glass and loosely stoppered. At four years and five months it differed little from No. 1476, and was still somewhat raw and immature.

No. 1519. *Palomino*, from Mission San José. A sample for must analysis was received October 1, 1891, in good condition, but not mature. The must showed 25.45% of solid contents by spindle and 0.53% of acid.

No. 1654. *Palomino*, from Paso Robles station. Received September 16, 1892, in good condition. The grapes and bunches were very small for the variety. The must showed 21.3% of solid contents by spindle and 0.39% of acid. The temperature of the grapes at crushing was 68°, and the maximum reached was 75°, on the third day. On the fourth day the wine was fortified.

At three weeks the wine was clear, and was racked. At three months it was bright, clean-tasting, nearly dry, and with low acid. At six months it was refortified, sweetened by the addition of a little rock-candy, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At ten months it was bright; it had the distinctive Palomino flavor, but had not yet developed much "rancio." Seventeen months later it had improved, but was lacking in delicacy. At three years and five months it was in good condition; the "rancio" taste was well developed, and the wine was a full-flavored Sherry of good quality.

No. 1671. *Palomino*, from Tulare station. Received September 19, 1892, in very good condition, and mature. The must showed 23.7% of solid contents by spindle and 0.32% of acid. The temperature of the grapes at crushing was 65°, and the maximum reached was 82°, on the third day. The wine was fortified on the sixth day.

In three weeks the wine was clear, and was racked. At three months it was bright and of good flavor, but too dry. At six months it was sweetened by the addition of a little rock-candy, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At ten months it was bright, but still very raw. At two years it was in good order, with full aroma and strong, characteristic flavor. Diluted with one third Beba to soften it and dilute its somewhat too prominent flavor, it made a good Sherry. At three years and five months it was in good order, more highly flavored than No. 1670, Pedro Jimenes, but less delicate and less mature.

No. 1780. *Palomino*, from Mission San José. Received October 15, 1892, in fair condition, but not mature. The must showed 20.5% of solid contents by spindle and 0.55% of acid. The temperature of the grapes at crushing was 58°, and the maximum reached was 81°, on the third day. On the seventh day the wine was dry and was drawn off from the thick lees.

In three weeks the wine was clear, and at one month it was racked for the second time. At three months it was bright, of rather good aroma and flavor, medium acid and body. Two months later it was in first-class condition and very agreeable. At five months it was racked for the third time, and remained perfectly bright until it was bottled. Tastings at eight, ten, and fourteen months showed gradual improvement and quick maturing; the wine tasted rather green, but had full, characteristic flavor, and kept well. At fifteen months it was mature, and was bottled. Two years after bottling the wine was bright and had made no deposit in the bottles; it was neutral, lacking in bouquet, but smooth and agreeable.

No. 1843. *Palomino*, from Tulare station. Received September 12, 1893, in good condition. The bunches were rather small and straggling. The must showed 21.95% of solid contents by spindle and 0.38% of acid. The temperature of the grapes at crushing was 65°, and the maximum reached was 81°, on the second day. The wine was fortified on the second day, when it had about 4% of solid contents.

At three months the wine was bright and of moderate sweetness. It was racked for the second time, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At ten months it was racked again. At two years and five months it was bright, full flavored, but still raw and undeveloped.

No. 1875. *Palomino*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition. The bunches varied very much in size; the berries were large, well-flavored, and nearly mature. The must showed 20.6% of solid contents by spindle and 0.47% of acid.

No. 1979. *Palomino*, from Tulare station. Received October 18, 1893, in good condition. The bunches were of medium size, loose and irregular; the berries large, round, or flattened vertically, sweet, and with very little acid. The must showed 23.7% of solid contents by spindle and 0.39% of acid. The temperature of the must at crushing was 61°, and the maximum reached was 78°, on the third day. The wine was fortified on the fifth day. At two months the wine was bright and had about the right amount of sweetness; it was racked for the second time, and at five months put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At nine months it was racked for the third time. At fourteen months it was in good order, smooth, and agreeable, with low acid and good flavor; in general, very promising.

No. 2019. *Palomino*, from Mission San José. Received October 26, 1893, in good condition. The bunches were large, conical, loose, but well filled; the berries of medium size, round, firm, and crisp, but not hard like the same variety from Tulare; the grapes were ripe and of agreeable flavor. The must showed 22.9% of solid contents by spindle and 0.61% of acid. The temperature of the grapes at crushing was 62°, and the maximum reached was 78°, on the third day. The wine was fortified on the sixth day.

At six weeks the wine was bright and a little too sweet. It was racked for the second time, and at two months was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At ten months it was racked for the third time, and at fourteen months it was bright and in good order, smooth and agreeable, with rather too much acid and not so much flavor as the Tulare sample. At two years and four months it showed some improvement; it was a good, clean-tasting wine, and had developed some Sherry character.

No. 2067. *Palomino*, from Cupertino. A sample for must analysis was received October 31, 1893, in good condition, and mature. The bunches were large, irregularly short, conical, and well filled; the berries over medium in size and well flavored. The must showed 24.8% of solid contents by spindle and 0.47% of acid.

BEBA.

(See Vit. Rept. 1883–85, p. 135.)

This variety is cultivated over a wide area in southwestern Spain, but nowhere in large quantities. It is used to some extent mixed with other grapes in the production of wines, but is esteemed principally as a table-grape and for keeping through the winter. In parts of the province of Cadiz it is used for the production of raisins. The grapes are dipped in lye before being dried.

Description.—The vine is of medium size, and buds early; the leaves are over average in size, five-lobed, with shallow sinuses, the lower often wanting, upper surface glabrous, the lower with a little close wool; bunches large, irregular, often branching, well-filled; berries medium to large, round, hard, and fleshy, without distinct flavor.

The Beba resembles very much the Palomino in the character of its grapes, which ripen about the same time and have the same tendency to be low in acid. It has shown, on the average, more sugar than the Palomino, but this may be accounted for by the fact that it has generally borne less. As to the quality of the wine, it is of very much the same character as that of the Palomino, but is rather more neutral and quite unfitted for the manufacture of dry wines.

ANALYSES OF MUSTS AND WINES.

BEBA.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six to Eight Months	Body	Ash	Sugar
						By Weight	By Volume				
1884—No. 271. Natoma	Oct. 7	22.60	--------	.25	--------	11.62	14.27	.50	2.10	.37	--------
1892—No. 1676. Tulare	Sept. 19	23.70	--------	.26	--------	*15.58	*19.18	.38	2.92	--------	1.18
1893—No. 1816. Tulare	Sept. 2	21.05	20.61	.38	.67	--------	*17.20	.41	2.90	--------	--------
No. 1854. Amador station	Sept. 12	22.60	--------	.49	--------	--------	--------	--------	--------	--------	--------
No. 1965. Paso Robles	Oct. 16	27.21	--------	.29	--------	--------	--------	--------	--------	--------	--------
1894—No. 2163. Amador station	Sept. 17	25.20	--------	.38	--------	--------	--------	--------	--------	--------	--------
No. 2169. Tulare	Sept. 18	24.80	24.12	.26	--------	--------	--------	--------	--------	--------	--------

* Fortified.

RECORD OF TREATMENT.

No. 1676. *Beba*, from Tulare station. Received September 21, 1892, in good condition. The must showed 23.7% of solid contents by spindle and 0.26% of acid. The temperature of the grapes at crushing was 69°, and the maximum reached was 82°, on the second day. On the fourth day the wine was fortified.

In two weeks the wine was clear, and was racked. At three months it was bright, of good flavor, but a little too dry. At six months it was racked for the third time, and was sweetened by the addition of a little rock-candy. At thirteen months it was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years and three months it was in good order, with full, rich flavor and good body, and aroma—a very good Sherry, equal to the Pedro Jimenes, but with rather less aroma; a little too sweet. Fourteen months later it had changed very little; it was a good Sherry, but not quite mature and a little bitter.

No. 1816. *Beba*, from Tulare station. Received September 4, 1893, in good condition. The bunches were large, irregular, fairly compact, but not compressed; the berries were round, over medium in size, with little flavor, but mature. The must showed 21.05% of solid contents by spindle and 0.38% of acid. The temperature of the grapes at crushing was 67°, and the maximum reached was 83°, on the third day. On the fourth day the wine was fortified while still sweet.

At three months the wine was bright and not quite sweet enough. It was racked for the second time, and at six months put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At ten months it was racked for the third time. At sixteen months it was bright, of good aroma, smooth and agreeable, but still raw. At two years and four months it was bright, with good, marked aroma and full flavor, but little "rancio," still undeveloped, but promising.

No. 1854. *Beba*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition, and mature. The bunches were rather small and straggling; the berries of all sizes. The must showed 22.6% of solid contents by spindle and 0.49% of acid.

No. 1965. *Beba*, from Paso Robles station. A sample for must analysis was received October 14, 1893, in good condition, but not quite mature. The bunches were of medium size, very branching, and irregular; the berries round, small, and hard. The must showed 27.2% of solid contents by spindle and 0.29% of acid.

PERRUNO.

There are several varieties of Perruno in southwestern Spain, one of which, the Perruno Comun, is planted in large quantities, and is considered the best wine-grape of the region, next to the Pedro Jimenes and the Palomino. The variety which is growing at the Experiment Stations seems, however, to be the Perruno duro, a variety which is much less extensively planted, but which is also held in high esteem for wine, and is, besides, much appreciated as a table-grape on account of the lateness of its period of ripening and the resistance of its grapes to the weather and decay.

Description.—Leaves of medium size, five-lobed, the upper lobes overlapping, glabrous above, with a little wool below, teeth very obtuse; bunches large and well filled; berries very large, round, hard, and with little flavor.

The Perruno has shown itself a vigorous grower and good bearer in the sandy, alkali soil of the Tulare station. Its must composition shows it to be preëminently a grape for sweet wines, but, like the Mantuo, its character is too neutral and requires the addition of some grape of higher quality. Though said to ripen very late in Spain, its period of ripening in California is considerably earlier than that of the Mantuo; it has also generally attained a higher sugar content than the latter, so that, on the whole, it is to be preferred to that variety.

Analyses of Musts and Wines.

PERRUNO.	Date of Picking	MUST.				WINE.				
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric at Six to Eight Months	Body	Sugar
						By Weight	By Volume			
1884—No. 268. Natoma	Oct. 8	22.76	------	.31	.31	9.92	12.35	.52	1.95	------
1892—No. 1687. Tulare	Sept. 27	22.60	22.23	.29	.40	*16.23	*19.96	.28	2.48	1.62
1893—No. 1874. Amador station	Sept. 12	18.40	------	.51	----	-------	-------	------	------	------
No. 1905. Tulare	Oct. 1	22.20	20.61	.41	.34	-------	*19.00	.48	2.88	.72
No. 1958. Paso Robles	Oct. 13	26.30	------	.15	---	-------	-------	------	-----	------
1894—No. 2184. Amador station	Sept. 22	24.10	------	.39	----	-------	-------	------	------	------
No. 2289. Tulare	Oct. 6	22.85	22.04	.35	----	-------	-------	------	------	------

*Fortified.

Record of Treatment.

No. 1687. *Perruno*, from Tulare station. Received September 29, 1892, in good condition. The must showed 22.6% of solid contents by spindle and 0.29% of acid. The temperature of the grapes at crushing was 72°, and the maximum reached was 80°, on the second day. On the fourth day the wine was fortified.

At three months, when it was racked for the first time, it was bright, but still very raw. At six months it was racked again, sweetened, and refortified. At twelve months it was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years it was in good order, with sufficient sugar and alcohol and full body; a fairly good Sherry, but coarse and not equal to Pedro Jimenes. It was much improved by the addition of one half No. 1705*a* (Napoleon). Fourteen months later it had much improved, was well aged, possessed of a good aroma and flavor, but was a little bitter.

No. 1874. *Perruno*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition. The bunches and berries were very large, but not quite mature and with little flavor. The must showed 18.4% of solid contents by spindle and 0.51% of acid.

No. 1905. *Perruno*, from Tulare station. Received October 2, 1893, in good condition. The bunches were very large and well filled; the berries very large, round, and hard, not quite mature, and very insipid. The must showed 22.2% of solid contents by spindle and 0.41% of acid. The temperature of the must at crushing was 70°, and the maximum reached was 82°, on the third day. On the fifth day the wine was fortified.

At two months the wine was clear and had very little sweetness. At this date it was racked, and again at six months, when it was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At nine months it was racked again, and at fourteen months it was in good condition—a smooth wine of good character, but very undeveloped and tasting of the cask. At two years and four months it had improved and was a good Sherry but for the taste and smell of the cask, which still persisted.

No. 1958. *Perruno*, from Paso Robles station. A sample for must analysis was received October 15, 1893, in good condition. The bunches were large, irregular, and loose; the berries of medium size, round, very hard, and fleshy. The must showed 26.3% of solid contents by spindle and 0.15% of acid.

MANTUO DE PILAS.

(See Vit. Rept. 1883–85, p. 133; 1885–86, p. 106.)

Synonyms: Monte Olivette; Uva de Rey; Gabriela.

This variety is much esteemed for wine-making in southwestern Spain, where it is planted in considerable quantities for blending with the Palomino, to which it is believed to add aroma. In some localities it is cultivated as a raisin-grape, and in others it is much esteemed as a table-grape. It is very useful for winter keeping, and in some vineyards is left on the vines till after the first autumn rains, to be shipped as a late eating-grape to the Madrid markets.

Description.—Vine productive; canes whitish and very hard; leaves large, with five distinct lobes, more or less overlapping when young, the sinuses much shallower when old, upper surface glabrous even when young, the lower white with close wool, teeth large; bunches large, pyramidal, winged, loose; berries very large, nearly round, crisp, fleshy, hard, and of neutral flavor.

This variety, next to the Pedro Jimenes, is the finest looking and largest of all white Spanish grapes growing at the Experiment Stations. It is rather later than the others, and requires a hotter climate, but at Tulare its fine bunches of large berries should make it very useful as a late table-grape. Its grapes show the same tendency to low acid as the other Sherry grapes in even a more marked degree. It makes a good sweet Sherry, but not quite equal in quality to either the Palomino or the Beba; it is quite neutral in character, and requires blending with a grape of more marked flavor.

Analyses of Musts and Wines.

MANTUO DE PILAS.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six to Eight Months	Body	Ash	Sugar
							By Weight	By Volume				
1884—No. 269.	Natoma	Oct. 8	18.63	------	.35	------	7.85	9.82	.53	1.32	.27	------
1885—No. 477.	Natoma	Sept. 19	20.40	20.02	.37	.42	7.78	9.73	.45	------	------	------
No. 497.	Natoma	Sept. 24	20.40	------	.28	------	8.48	10.58	.35	------	------	------
1892—No. 1688.	Tulare	Sept. 27	23.50	23.42	.37	.58	*14.64	*18.03	.31	2.53	------	1.77
1893—No. 1877.	Amador station	Sept. 12	19.30	------	.50	------	------	------	------	------	------	------
No. 1957.	Paso Robles	Oct. 14	22.75	------	.30	------	------	------	------	------	------	------
No. 1966.	Tulare	Oct. 12	21.50	20.17	.38	.48	------	*17.50	.35	3.30	------	------
1894—No. 2182.	Amador station	Sept. 22	22.10	------	.40	------	------	------	------	------	------	------
No. 2332.	Tulare	Oct. 13	23.30	22.23	.32	------	------	------	------	------	------	------

*Fortified.

Record of Treatment.

No. 1688. *Mantuo de Pilas*, from Tulare station. Received September 29, 1892, in good condition. The must showed 23.5% of solid contents by spindle and 0.37% of acid. The temperature of the grapes at crushing was 71°, and the maximum reached was 79°, on the second day. The wine was fortified on the fourth day.

In six weeks the wine was clear, and was racked. At two months it was bright, of good flavor, but too dry. At three months it was racked for the second time, and at six months it was sweetened with rock-candy, and refortified. At one year it was put in the heating-chamber, at a temperature of from 90° to 95°. At two years and two months it was in good order—a good, light Sherry, more delicate than No. 1687 (Perruno), but with less character than the Pedro Jimenes. Fourteen months later it had improved, but was still raw.

No. 1877. *Mantuo de Pilas*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition. Both bunches and berries were very large, and closely resembled Mourisco branco. The must showed 19.3% of solid contents by spindle and 0.50% of acid.

No. 1957. *Mantuo de Pilas*, from Paso Robles station. A sample for must analysis was received October 15, 1893, in fair condition. The bunches were large, pyramidal, winged, loose; the berries of medium size, round, crisp but not hard, not very sweet, and with little flavor. The must showed 22.75% of solid contents by spindle and 0.30% of acid.

No. 1966. *Mantuo de Pilas*, from Tulare station. Received October 14, 1893, in very good condition. The bunches were large, irregular, loose; the berries very large, slightly oval, crisp, and with very little acid. The must showed 21.5% of solid contents by spindle and 0.38% of acid. The temperature of the grapes at crushing was 62°, and the maximum reached was 78°, on the second day. On the fifth day the wine was fortified.

At two months the wine was bright, but too dry. It was racked first at two months and then at five months, when it was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At nine months it was racked again, and at fourteen months it was in good order, neutral, with little aroma or flavor, and still very raw.

MOURISCO BRANCO.

(See Vit. Rept. 1883–85, p. 134; 1885–86, p. 107.)

The Mourisco branco is a large, white grape of the Douro region of Portugal. It is very common and, unlike its black congener, the Mourisco preto, is used principally for the table. For this purpose it is very much esteemed.

Description.—Canes chestnut-colored; leaves rather large, round in outline, with shallow sinuses, upper lobes overlapping, upper surface quite glabrous, lower with a little close, white wool, which disappears with age; bunches large, irregular, winged, loose; berries large to very large, round, flattened at the ends, crisp, on slender pedicels.

This variety has a close family resemblance to the large, white Sherry grapes of southwestern Spain, but is not identical with any of the varieties which are planted at the Experiment Stations, so far as is yet made out. In must composition, general appearance of grapes, and time of ripening, it has a strong resemblance to the Mantuo de Pilas, but the berries are less hard and there is a considerable difference in the leaves. It has not yet been tested sufficiently for an opinion to be ventured as to its suitability to California, but the indications are that it will be useful as a sweet-wine grape in localities similar to those which are suitable to the grapes of Jerez.

ANALYSES OF MUSTS AND WINES.

MOURISCO BRANCO.	Date of Picking	MUST.				WINE.				
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six to Eight Months	Body	Ash
						By Weight	By Volume			
1884—No. 270. Natoma	Oct. 7	22.60	------	.25	----	*11.62	*14.27	.50	2.10	.37
1885—No. 482. Natoma	Sept. 20	25.10	24.97	.31	.40	10.07	12.54	.33	----	---
1892—No. 1716. Tulare	Oct. 3	23.40	------	.33	----	--------	--------	------	----	---
1893—No. 1876. Amador station	Sept. 14	18.20	------	.60	----	--------	--------	------	----	---
No. 1970. Tulare	Oct. 14	23.50	21.80	.32	.34	*14.97	*19.08	.30	3.10	---
1894—No. 2183. Amador station	Sept. 22	20.00	------	.49	----	-------	--------	------	----	---
No. 2312. Tulare	Oct. 11	22.60	------	.30	----	--------	--------	------	----	---

* Fortified.

RECORD OF TREATMENT.

No. 1716. *Mourisco branco*, from Tulare station. A sample for must analysis was received October 5, 1892, in good condition. The must showed 23.4% of solid contents by spindle and 0.33% of acid.

No. 1876. *Mourisco branco*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition. The bunches and berries were very large, without much flavor, and immature. The must showed 18.2% of solid contents by spindle and 0.60% of acid.

No. 1970. *Mourisco branco*, from Tulare station. Received October 16, 1893, in good condition. The bunches were large, irregular, winged, loose; the berries very large, round, flattened at the ends, crisp, on slender pedicels. The must showed 23.5% of solid contents by spindle and 0.32% of acid. The temperature of the grapes at crushing was 63°, and the maximum reached was 74°, on the third day. On the fifth day the wine was fortified.

At two months the wine was bright, of good bouquet and flavor and slight sweetness. It was racked, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At ten months it was racked again. At three years and four months it was in good condition, showed marked aroma and flavor, clean taste, moderate sweetness, little "rancio," still raw and undeveloped.

VERDELHO.

(See Vit. Rept. 1883-85, p. 135; 1885-86, p. 106.)

Synonym: Verdelho di Madeira.

This grape is cultivated extensively in the Island of Madeira, where it enters into the finest grades of wines, especially of dry wines. It is almost or quite equal in quality to the Sercial, the principal dry-wine grape of Madeira, and superior in productiveness and robustness. It is cultivated to some extent in France, but more for the table than for wine. It has been introduced successfully into the Crimea, and was among the first varieties to give satisfactory results in Australia.

Description.—The vine is vigorous, and productive in bunches, which are, however, of very light weight; it bears well with short-pruning; the canes are slender, short-jointed, with a light reddish tint; leaves small to medium, wider than long, the petiolar sinus open, the others small or absent, glabrous on both surfaces except for a little down on the main nerves, teeth distinctly mucronate; the bunches are small, winged or branched, and loose; the berries small, regular, ellipsoidal, on long, slender pedicels, of a transparent green color, becoming yellowish at maturity; flesh firm, sweet, and agreeably flavored.

The Verdelho ripens early, even in the coast counties, a week or two after the Chasselas; it is somewhat subject to coulure and mildew, but resists the weather well. The grapes are not injured by rain, on account of the looseness of the bunches, and they shrivel up gradually with overripeness. They attain regularly a high degree of sugar, and maintain a much larger percentage of acid than the Spanish Sherry grapes. The average composition of the must has been: at Cupertino and Mission San José, 26.9% of solid contents by spindle and 0.54% of acid; at Fresno and Tulare, 26.4% and 0.55%; at Paso Robles, 25.1% and 0.60%; at Amador station, 26.7% and 0.54%. Such similarity in results from such dissimilar localities shows a wide adaptability for this grape, and also indicates its value for the production of dry Sherries. It acquires a marked and delicate "rancio" flavor very quickly and easily, and its full aroma and high quality make it very valuable as an addition in the making of sweet wines. Its acid is too high to give the best results as a sweet wine when used alone, but the addition of one third to the neutral Sherry grapes with low acid, such as the Perruno, Mantuo, or Pedro Jimenes, is of great advantage to the latter.

TABLE OF PRODUCTION.

VERDELHO.	Number of Vines	Total Weight of Grapes, in lbs.	Average per Vine, in lbs.	Date of Picking
1887—No. 766. J. T. Doyle, Cupertino	20	28	1.4	Oct. 20
1888—No. 867. J. T. Doyle, Cupertino	19	62	3.2	Sept. 27
1889—No. 1100. J. T. Doyle, Cupertino	19	75	3.9	Sept. 26
1887-96. E. W. Hilgard, Mission San José, average	320	900	2.8	--------

ANALYSES OF MUSTS AND WINES.

VERDELHO.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Body	Ash	Sugar
1884—No. 272. Natoma Wine Co., Natoma		27.35	25.88	.50	.37	*12.39	15.20	.42	2.82	.33	
1886—No. 568. E. W. Hilgard, Mission San José		25.90		1.00							
1887—No. 766. J. T. Doyle, Cupertino	Oct. 20	30.04	31.48	.49	.45						
1888—No. 838. J. Gallegos, Mission San José	Sept. 9	26.42		.57							
No. 867. J. T. Doyle, Cupertino	Sept. 27	24.15	24.33	.46	.26	9.85	12.27	.64	2.70		
No. 914. E. W. Hilgard, Mission San José	Oct. 16	28.22		.34	.32	*12.39	15.20	.41	2.95		
1889—No. 1100. J. T. Doyle, Cupertino	Sept. 26	26.90	26.99	.54	.40	10.81	13.27	.44	2.86		
1890—No. 1203. Margherita Vineyard, Fresno	Aug. 11	24.10	24.64	.65	.52	*14.75	18.22	.55	2.96		4.60
No. 1297. J. Gallegos, Mission San José	Oct. 1	25.90		.71	.22	*13.77	16.98	.72	3.06		4.50
No. 1322. J. T. Doyle, Cupertino	Oct. 11	27.65		.55							
1891—No. 1451. Tulare	Aug. 26	26.30		.56							
No. 1466. Fresno	Aug. 28	29.10		.54		*16.85	20.71	.45	2.99		1.36
No. 1466*a*. Fresno	Aug. 28	29.10		.54		*15.92	19.59	.36	3.02		1.58
No. 1485. Paso Robles	Sept. 9	24.10		.55							
No. 1518. Mission San José	Oct. 18	26.05	26.99	.71		*16.08	19.78	.51	3.80		
1892—No. 1689. Tulare	Sept. 26	25.90	27.65	.49		*16.46	20.24	.36	2.95		1.20
1893—No. 1859. Amador station	Sept. 13	26.10		.63							
No. 1904. Tulare	Oct. 1	25.75	25.76	.58	.43		19.90	.53	3.10		
No. 2013. Mission San José	Oct. 29	28.40	27.70	.55	.30						
No. 2102. Cupertino	Nov. 4	27.70		.44							
1894—No. 2180. Amador station	Sept. 22	27.35		.45							
No. 2219. Paso Robles	Sept. 26	26.06		.66							
No. 2220. Tulare	Oct. 1	27.15	26.31	.49							
No. 2249. Mission San José	Oct. 3	24.60		.55							

*Fortified.

RECORD OF TREATMENT.

No. 766. *Verdelho*, from Cupertino. Received October 21, 1887, in good condition. The grapes showed a great deal of early coulure (quite 50%), and the stems were somewhat shriveled. The bunches were large in comparison with the figure in "Les Vignobles," with which otherwise they agreed perfectly. The grapes were very sweet, with little acid, and in proper condition for making into wine. The must showed 30.04% of solid contents by spindle and 0.49% of acid. On October 23d, 25.5 lbs. were crushed. The maximum temperature reached was 82°, on the second day. The wine remained at that temperature for thirty-six hours. The grapes yielded wine at the rate of 142 gals. per ton. The wine was put in glass and unfortunately lost by breakage.

No. 838. *Verdelho*, from Mission San José. A sample for must analysis was received September 12, 1888, in good condition. The must showed 26.42% of solid contents by spindle and 0.57% of acid.

No. 867. *Verdelho*, from Cupertino. The grapes were received September 28, 1888, in good condition, and worked the same day. They showed from 25% to 80% of coulure, and were not quite ripe enough for Verdelho. The must showed 24.15% of solid contents by spindle and 0.46% of acid. The 41 lbs. of grapes crushed yielded 3.4 gals. of wine, or at the rate of 164 gals. per ton. The must started fermenting at a temperature of 63°, and gradually rose to a maximum of 78°, on the fourth day; it continued fermenting for six days more, when it was drawn off at a temperature of 73°.

One month after pressing the wine, being quite quiet, was taken to the cellar. Two months later it had become slightly cloudy; it was, however, of good quality, with low acid, sufficient alcohol and body, and characteristic aroma. Two months later it was pasteurized, as the lees showed some unsound germs. At eight months it was racked for the third time. At ten months it was not quite bright, but of good flavor and bouquet—would be of excellent quality but for suspicion of bad acid. Four months later, when it was racked again, it was bright and considerably improved. At sixteen months it was bright, full-flavored, and mature. The wine had been put in glass at fourteen months, but had deposited no sediment. At one year later it was clear, but had made a slight deposit. It was of good quality, with Sherry-like bouquet, but slightly bitter and lacking in freshness. Eighteen months later it had changed very little. At seven years from the time of making it was a fairly drinkable wine, showing good quality, of Sherry character, but still showed the effect of the slight unsound fermentation which it underwent before it was pasteurized.

No. 914. *Verdelho*, from Mission San José. The grapes were received October 18, 1888, and worked the same day. They were overripe, somewhat shriveled and soft, a few dried up to raisins, and a very few moldy. Considering that the grapes were from two-year-old grafts, and had been long exposed to foggy and changeable weather since ripening, they were in excellent condition. The must showed 28.22% of solid contents by spindle and 0.34% of acid. From 91 lbs. of grapes crushed, 7.2 gals. of wine were obtained, or at the rate of 156.6 gals. per ton. The temperature of the must at starting was 67°, and the maximum reached was 82°, on the fifth day. The wine was drawn off on the seventh day after a good fermentation.

Five weeks later the wine was racked and taken to the cellar. At three months it was still slightly cloudy, but of decided and agreeable Sherry aroma, full alcohol, and pleasing acid. Two months later it was in good condition and the lees were sound. At ten months it was clear, of good quality, a very pleasing dry Sherry. At fourteen months the wine in the keg was very good, but had a slightly bitter after-taste. Some of the wine which had been put in bottle at five months was sound, but undeveloped. At sixteen months the lees showed bitter ferments under the microscope. The wine was not quite bright, but was good except for the slight bitterness. The wine in bottle had not acquired the bitter taste. Five months later the wine had improved and was nearly mature. At twenty-two months it was bottled. At two years and four months the wine bottled at fifteen months was bright, of good flavor and bouquet, and with little deposit. That bottled at twenty-one months was similar, but rather darker in color. At four years both wines were of good quality, but that bottled first was cleaner-tasting and of richer flavor. At seven years the wine was clean-tasting, full-flavored, with a pronounced "rancio" taste, but lacking in bouquet.

No. 1100. *Verdelho*, from Cupertino. Received September 27, 1889, in fair condition, showing somewhat irregular ripening. The must showed 26.9% of solid contents by spindle and 0.54% of acid. From 70.5 lbs. crushed were obtained 5.1 gals. of wine, or at the rate of 143.6 gals. per ton. The must began fermenting at a temperature of 72°, and reached a maximum of 82° on the second day. The wine was dry on the eighth day, when it was drawn off.

At one month the wine was racked and taken to the cellar. It was clear, of full and agreeable aroma and low acid; it was a fruity wine, of high quality. At three months it had progressed well, was clear, solid, and of Sherry character. The lees were examined and found to be sound. Three months later it was in good condition, and was racked again. At this time the lees were sound, and two months later the wine was bright, with full, rich bouquet and flavor, and well advanced toward maturity. At fifteen months it was still bright, but began to show the effect of being in so small a keg, and in order to preserve it, it was pasteurized and put in bottle. A year later it was bright and had improved somewhat. At three years it showed good quality, but also the effect of being made in so small a quantity.

No. 1203. *Verdelho*, from Fresno. Received August 14, 1890, in excellent condition. The grapes were of unequal ripeness, and some of them tasted green. The bunches were of medium size and well filled; the berries small, both bunches and berries very uniform in size. The must showed 24.1% of solid contents by spindle and 0.65% of acid. The temperature of the must at crushing was 69°, and the maximum reached was 98°, on the third day. The fermentation was conducted in a room kept at an average temperature of 95°. On the seventh day the wine was evidently stuck with over 10% of solid contents. It was racked from the thick lees and left in the hot room. On the ninth day 3 pro mille of ammonium phosphate was added to it. This revived the fermentation a little, but the wine stuck again with 9% of solid contents.

At three weeks the wine had still 9% of solid contents, and showed large quantities of the mannite ferment under the microscope. The wine was racked and fortified. At three months it was clear, but of unpleasing odor. Two months later it was racked again and refortified. At nine months it was placed in the heating-chamber, at a temperature of 100°, for three months. At eighteen months it was bright and improved; it had some bouquet and flavor, but was too acid and did not promise to be anything fine; it was racked for the fourth time. Two years later it had improved very much, was smooth, clean-tasting, and of good Sherry flavor. At twenty-seven months it was a good wine and fairly well matured, its chief fault being too high acidity. It was put in glass, and fifteen months later was bright, of good aroma and full flavor. It was a sweet wine of good quality, its only serious fault being too much acidity.

No. 1297. *Verdelho*, from Mission San José. Received October 3, 1890, in good condition, and completely mature. The grapes were smaller than usual. The must showed 25.9% of solid contents by spindle and 0.71% of acid. The temperature of the must at crushing was 67°, and the maximum reached was 81°, on the third day. It was fortified on the fourth day.

At one month the wine was nearly clear, but showed poor quality, lacked aroma, and was too high in acid. Two months later it was bright, had improved a little, but was very flavorless. At this time it had 16% of alcohol and 7.9% of solid contents. Two months later it was refortified. At seven months it was put in the heating-chamber, at a temperature of 105°, for three months. At fifteen months it had improved, was bright, and had acquired a rather pleasing but not marked bouquet. It was, however, too thin and too acid to ever make a good Sherry. At this date it was racked for the fifth time. Two years later it was in good condition, clean-tasting, improved in flavor and aroma, but still too acid and a little too sweet. When four years old it was put in glass, and corked loosely. At five years the wine was in good condition, but not nearly so good a wine as No. 1203, Verdelho, from Fresno. It lacked character and was slightly bitter.

No. 1322. *Verdelho*, from Cupertino. A sample for must analysis was received October 11, 1890, in fair condition, and quite mature, some of the berries being dried up. The must showed 27.65% of solid contents by spindle and 0.55% of acid.

No. 1451. *Verdelho*, from Tulare station. A sample for must analysis was received August 29, 1891, in good condition. The must showed 26.3% of solid contents by spindle and 0.56% of acid.

No. 1466. *Verdelho*, from Fresno. Received August 31, 1891, in good condition. The must showed 29.1% of solid contents by spindle and 0.54% of acid. The grapes were divided into two lots, No. 1466 and No. 1466*a*, which were fermented separately.

No. 1466. The temperature of the must at starting was 66°, and the maximum reached was 76°, on the fourth day. On the seventh day, when the wine was still a little sweet, it was fortified. When the wine was four months old it was bright, straw-colored, full-flavored, and with medium sweetness. A month later it was racked for the second time, and at six months put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years and a half it was in good condition, with full aroma, good Sherry taste, clean and smooth—a very good wine. At three years and two months it was in excellent order and had matured well. It was put in glass, and at four years and five months was a good, full-flavored Sherry.

No. 1466*a*. The temperature of the must at starting was 66°. The day after crushing, one third of a gallon of spirits of 70% strength was added, thus fortifying the must to a strength of 4.6% of alcohol. The maximum temperature of the must was 74°, reached on the fourth day. The wine continued fermenting for fifteen days, when it was fortified with the necessary quantity of spirits. At four months the wine was bright, straw-colored, of medium sweetness, slightly bitter, and not as good as No. 1466. A month later it was racked, and at six months put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years and a half, it differed little from No. 1466, except that it was slightly less acid. At three years and two months it was very good, of excellent flavor and aroma, and maturing well. It was put in glass, and at four years and five months it was brighter and smoother than No. 1466, but otherwise little different.

No. 1485. *Verdelho*, from Paso Robles station. A sample for must analysis was received September 9, 1891, in good condition. The must showed 24.1% of solid contents by spindle and 0.55% of acid.

No. 1518. *Verdelho*, from Mission San José. Received October 19, 1891, in good condition. The must showed 26.05% of solid contents by spindle and 0.71% of acid. The must commenced fermenting at a temperature of 67°, and reached a maximum of 76°, on the fourth day. On the ninth day, while the wine was still sweet, it was fortified.

At three months the wine was bright and clean-tasting; both the acid and the sugar were a little too high. At four months it was racked for the second time, and at five months put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years and nine months it was bright, of good aroma and flavor, and clean-tasting; it was smooth and agreeable, but a little too sweet. Four months later it had not changed much, had developed little of the Sherry flavor, and the acid was a little too high. At four years and four months it had improved very much, was clean-tasting, and had developed a good aroma; it was a very good Sherry.

No. 1689. *Verdelho*, from Tulare station. Received September 29, 1892, in good condition. The must showed 25.9% of solid contents by spindle and 0.49% of acid The temperature of the grapes at crushing was 72°, and the maximum reached was 79°, on the second day. On the fifth day the wine was fortified.

In ten weeks the wine was bright, but not agreeable. At five months it was racked for the second time, refortified, and sweetened by the addition of a little sugar. When twelve months old it was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years and two months it was in good order, showed character, but was not quite clean-tasting, nor equal to Beba and Pedro Jimenes of the same age in smoothness and development. Fourteen months later it had improved and showed marked character, but was still a little raw-tasting.

No. 1859. *Verdelho*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition. The grapes were small and sweet, and in small, loose bunches. The must showed 26.1% of solid contents by spindle and 0.63% of acid.

No. 1904. *Verdelho*, from Tulare station. Received October 2, 1893, in good condition. The bunches were small, well filled, but not compacted; the berries were large for the variety, and mature. The must showed 25.75% of solid contents by spindle and 0.58% of acid. The temperature of the grapes at crushing was 70°, and the maximum reached was 86°, on the third day. The wine was fortified on the fifth day.

At two months the wine was bright and of good aroma, but too dry. It was racked for the second time, and at eight months put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At eleven months it was racked again, and at fourteen months it was smooth and agreeable, but undeveloped and slightly bitter. At two years and four months it was bright, of good flavor and aroma; a good Sherry, but still rather raw.

No. 2013. *Verdelho*, from Mission San José. A sample for must analysis was received October 26, 1893, in good condition. The bunches were of small to medium size, branching, showing some coulure; the berries small and very sweet. The must showed 28.4% of solid contents by spindle and 0.55% of acid.

No. 2102. *Verdelho*, from Cupertino. A sample for must analysis was received November 6, 1893, in good condition. The bunches were small, irregularly conical, with small wings, loose, and showing some coulure; the berries small, pulpy, very sweet, and much past maturity. The must showed 27.7% of solid contents by spindle and 0.44% of acid.

BOAL DE MADEIRA.

(See Vit. Rept. 1883-85, p. 136.)

The variety imported into California under the above name is probably one of the several varieties of Boal which are widely distributed in Portugal. As no adequate descriptions of these varieties are available, it is impossible to say which we have. The chief varieties are the *Boal cachudo* or *commun*, and the *Boal calhariz;* these are grown extensively in many localities, and are generally very productive and satisfactory as to the quality of the wine. The Boal is said to be adapted to divers soils, the grapes ripen early, and are easily injured by wet weather.

Description.—Canes slender and short-jointed; leaves of medium size, longer than broad, with five well-marked sinuses and occasionally two or three secondary ones, lobes overlapping, upper surface with loose, flocculent wool, disappearing at maturity, lower surface closely white-woolly, teeth irregular and acuminate; bunches large, branching, loose;

berries small, ellipsoidal, soft, and juicy, on long and slender pedicels; skin fairly thick, but tender.

The Boal in California has, so far, given small to fair crops, except at Natoma, where it is said to have borne heavily. This is in accordance with the reports from Portugal, where, in some districts, it is considered a heavy bearer, and in others as a light one. It ripens rather later than the Verdelho, and is equally subject to coulure. The average composition of the must has been: at Mission San José and Cupertino, 26.0% of sugar and 0.58% of acid; at Tulare and Fresno, 25.75% of sugar and 0.45% of acid; at Amador, 27.58% of sugar and 0.45% of acid; at Paso Robles, 27.55% of sugar and 0.40% of acid. These figures resemble greatly those found for the Verdelho. It attains a high amount of sugar in all localities, and maintains its acid well. This would indicate its value as a grape for dry Sherries. It would make an excellent blend for this purpose with the Verdelho, which has more character. It makes a rather agreeable sweet wine, but no better, if as good, as several Spanish grapes which are much heavier bearers. Altogether this variety shows few good points in which it is not equaled or surpassed by the Verdelho. It is, however, worthy of further trial in the foothill and southern regions.

ANALYSES OF MUSTS AND WINES.

BOAL DE MADEIRA.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Body	Ash	Sugar
1884—No. 273. Natoma Wine Co., Natoma	Sept. 3	21.76	-----	.53	-----	9.27	11.58	.66	2.00	.26	-----
1889—No. 1085. J. Gallegos, Mission San José	Sept. 16	26.30	26.12	.62	.38	10.44	12.91	.48	2.30	-----	-----
1890—No. 1300. J. Gallegos, Mission San José	Oct. 4	25.00	-----	.57	.31	13.77*	17.00	.30	3.14	-----	1.31
No. 1393. J. T. Doyle, Cupertino	Oct. 18	27.15	-----	.48	-----	-----	-----	-----	-----	-----	-----
1891—No. 1473. Fresno	Aug. 29	26.30	-----	.50	.36	17.25*	21.19	.41	3.09	-----	3.09
No. 1570. Mission San José	Oct. 7	26.90	-----	.57	-----	-----	-----	-----	-----	-----	-----
1893—No. 1873. Amador station	Sept. 14	25.60	-----	.53	-----	-----	-----	-----	-----	-----	-----
No. 1951. Mission San José	Oct. 14	24.80	-----	.90	-----	-----	-----	-----	-----	-----	-----
No. 1962. Paso Robles	Oct. 16	26.50	-----	.34	-----	-----	-----	-----	-----	-----	-----
No. 2095. Cupertino	Nov. 4	28.40	-----	.45	-----	-----	-----	-----	-----	-----	-----
1894—No. 2140. Amador station	Sept. 11	29.55	-----	.37	-----	-----	-----	-----	-----	-----	-----
No. 2213. Paso Robles	Sept. 24	28.60	-----	.45	-----	-----	-----	-----	-----	-----	-----
No. 2248. Mission San José	Oct. 3	23.70	-----	.48	-----	-----	-----	-----	-----	-----	-----
No. 2331. Tulare	Oct. 13	25.20	-----	.40	-----	-----	-----	-----	-----	-----	-----

* Fortified.

Record of Treatment.

No. 1085. *Boal de Madeira*, from Mission San José. Received September 19, 1889, in poor condition; many grapes were dried up. The bunches were rather large, branching, loose; the berries small, ellipsoidal; stems and pedicels long and slender; flesh firm and agreeably flavored; skin thick, but tender. The must showed 26.3% of solid contents by spindle and 0.62% of acid. The yield from the 62.5 lbs. crushed was 4.4 gals., or at the rate of 140 gals. per ton. The temperature of the grapes at crushing was 71°, and the maximum reached was 82.5°, on the third day.

The wine was dry on the sixth day, and was drawn off the thick lees. At three weeks it was almost clear, of agreeable flavor, but slightly bitter. Nine days later it was clear and clean-tasting, and was racked and taken to the cellar. At four months it was in good condition, golden-green in color, of agreeable flavor, and good body, acid, and alcohol. The taste was still a little bitter, but the lees showed no bad germs. At seven months the wine was racked again; it was bright, but had a suspicious taste, and the lees showed some filaments. A month later it had become cloudy, and was pasteurized. After this it did not improve, as the pasteurizing had been done too late and after the flavor had already been impaired. The wine, however, became no worse, and at eighteen months it was distilled.

No. 1300. *Boal de Madeira*, from Mission San José. Received October 7, 1890, in poor condition. The must showed 25.0% of solid contents by spindle and 0.57% of acid. The temperature of the grapes at crushing was 67°, and the maximum reached was 73°, on the third day. On the fifth day the wine was fortified.

At one month the wine was clear, with little flavor or aroma, moderate alcohol and acid, and right amount of sweetness. At three months it was bright and improved, but tasted somewhat bitter, and the spirits had not become well incorporated. It was racked for the second time, and two months later refortified. At seven months it was put in the heating-chamber, at a temperature of 105°, for three months. At sixteen months the wine had much improved, had developed some bouquet, and was of very pleasing flavor. It was racked again, and two years later it had retained its good qualities, but, owing to the smallness of the quantity, it had become too concentrated by evaporation. At four years it was in excellent order, mature and good, but not quite clean-tasting; at this date it was bottled. At five years and four months it was in good condition, full-flavored and mature, with strong "rancio" taste, but lacking in delicacy.

No. 1393. *Boal de Madeira*, from Cupertino. A sample for must analysis was received October 21, 1890, in poor condition, many grapes being crushed and others dried. The must showed 27.15% of solid contents by spindle and 0.48% of acid.

No. 1473. *Boal de Madeira*, from Fresno. Received August 31, 1891, in good condition. The must showed 26.3% of solid contents by spindle and 0.50% of acid. The temperature of the grapes at crushing was 70°, and the maximum reached was 77°, on the third day. On the sixth day the wine was fortified.

At four months the wine was bright, of good aroma and flavor, and low sugar contents. A month later it was racked for the second time, and at six months put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years and ten months it was bright and of good aroma, but a little bitter. The quantity was too small to keep well. Four months later it had improved a little, and was put in glass. At four years and five months it was in good order, had full aroma and strong "rancio" taste, but was not quite clean-tasting.

No. 1570. *Boal de Madeira*, from Mission San José. A sample for must analysis was received October 9, 1891, in good condition. The must showed 26.9% of solid contents by spindle and 0.57% of acid.

No. 1873. *Boal de Madeira*, from Amador station. A sample for must analysis was received September 16, 1893, in good condition. The bunches were large; the berries rather small and quite ripe. The must showed 25.6% of solid contents by spindle and 0.53% of acid.

No. 1951. *Boal de Madeira*, from Mission San José. A sample for must analysis was received October 14, 1893, in good condition. The bunches were large, loose, and straggling, the berries loose. The must showed 24.8% of solid contents by spindle and 0.90% of acid.

No. 1962. *Boal de Madeira*, from Paso Robles station. A sample for must analysis was received October 14, 1893, in fair condition. The bunches were of medium size, loose, irregularly conical; the berries small, oval, soft and juicy, and quite mature. The must showed 26.5% of solid contents by spindle and 0.34% of acid.

No. 2095. *Boal de Madeira*, from Cupertino. A sample for must analysis was received November 6, 1893, in good condition. The bunches were of medium size, irregularly conical, branching or winged, loose, and coulured; the berries small, oval, soft, and overripe. Some of the berries were shriveled. The must showed 28.4% of solid contents by spindle and 0.45% of acid.

MALMSEY.*

(See Vit. Rept. 1883–85, p. 138.)

Synonyms: Malvasia Grossa; Malvoisie à gros grains; Vermentino.

The Malmsey, or Vermentino, is cultivated in northern Portugal, Corsica, and the Island of Madeira for wine, and to a limited extent in the south of France as a table-grape. There are two varieties of Malvoisie cultivated in Madeira, but the one to which the famous Malmsey wine, or Madeira Malvoisie, owed its reputation is a smaller grape of higher quality than the Vermentino. The Vermentino, however, makes an excellent sweet wine, both in Madeira and in Corsica, and is much appreciated as a table-grape in parts of southern France.

Description.—Vine fairly vigorous and very productive in rich soils; canes slender; leaves small to medium, with five deep sinuses and overlapping lobes, the bases of the sinuses looking like four or five roundish holes, after the manner of the Cabernet Sauvignon, upper surface glabrous, lower close woolly; bunches very large and irregular, loose, and with large wings; berries large, oval, appressed at the base; peduncles herbaceous and slender; pedicels much enlarged at the base of the berries, and about three times their length; skin very thin, with light bloom; flesh very juicy, and with delicate Muscat aroma.

This variety has borne well at Tulare with short-pruning; it has shown some tendency to coulure, but the bunches are generally well filled. It ripens rather late, but if given time and not allowed to bear too heavily, will attain a high percentage of sugar. It develops little acid, and this, taken together with its high aroma, makes it very suitable for the manufacture of sweet wines or liqueurs. It can be used also in limited quantities to give aroma to common dry white wines in the hot valleys, when these wines are intended for early consumption. The marked aroma of this grape differs considerably from that of the Muscats, being more delicate and its wine more agreeable. The grape would be excellent for the table but for the delicacy of the skin, which makes it unfit for shipping.

Analyses of Musts and Wines.

MALMSEY.	Date of Picking	MUST.				WINE.				
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Body	Ash
1884—No. 275. Natoma	Sept. 7	17.91	------	.56	----	7.92	9.91	.54	1.60	.16
1892—No. 1698. Tulare	Sept. 28	22.40	------	.47	----	------	------	------	------	----
1893—No. 1901. Tulare	Sept. 27	20.60	------	.45	.38	†	------	------	------	----
No. 1959. Paso Robles	Oct. 12	25.90	------	.33	----	------	------	------	------	----
1894—No. 2286. Tulare	Oct. 6	23.15	21.80	.34	----	------	------	------	------	----

Record of Treatment.

No. 1698. *Malmsey*, from Tulare station. A sample for must analysis was received September 29, 1892, in good condition. The grapes were large and thin-skinned. The must showed 22.4% of solid contents by spindle and 0.47% of acid.

No. 1901. *Malmsey*, from Tulare station. Received September 29, 1893, in good condition. The bunches were very large (most of them had been broken up for convenience of packing) and irregular, loose, with large wings, showing some coulure; the berries were large, oval, appressed at the base; peduncles herbaceous and slender; pedicels much enlarged at base of berries, which are about three times their length; skin very thin, with light bloom; flesh very juicy, with delicate Muscat aroma. The must showed 20.6% of solid contents by spindle and 0.45% of acid. The grapes were fermented with No. 1900, Pedro Jimenes.

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* Corruption of Malvoisie, but not the grape so called in California.

† See No. 1900, Pedro Jimenes.

No. 1959. *Malmsey*, from Paso Robles station. A sample for must analysis was received October 14, 1893, in fair condition. The bunches were large, conical, loose; the berries ovoid, juicy, thin-skinned, very well flavored. The must showed 25.9% of solid contents by spindle and 0.33% of acid.

WEST'S WHITE PROLIFIC.

(See Vit. Rept. 1885-86, p. 108.)

The true name of this variety has not yet been ascertained, but under its California name (derived from its introduction by Mr. W. B. West, of San Joaquin County) it has been rather widely distributed, and is planted in notable quantities in many California vineyards.

Description.—Vine vigorous; canes light brown and rather slender; leaves of good size, without or with only two shallow sinuses, glabrous above, loose-woolly beneath, with very short obtuse teeth; bunches medium to large, long conico-cylindrical, loose or compact, occasionally shouldered; berries of medium size, slightly ovoid, juicy, and of neutral flavor.

This variety has been somewhat extensively recommended as a brandy and as a Sherry grape. For the production of brandy there can be no doubt of its value for certain localities. It is an excellent bearer in rich soils, and maintains a good amount of acid, even in the hottest localities. It ferments well, and its neutral character and the absence of any marked aroma render it eminently suitable for the production of light, neutral blending wines in the San Joaquin Valley. For the production of Sherries or other sweet wines, however, it cannot now be recommended in the presence of several much superior grapes. The average composition of the must has been: at Cupertino and Mission San José, 23.2% of sugar and 0.76% of acid; at Fresno and Tulare, 25.1% of sugar and 0.62% of acid; at Paso Robles, 24.7% of sugar and 0.56% of acid; at Amador station, 25.2% of sugar and 0.75% of acid. These figures show that this variety is one of the best we have for maintaining a full amount of acid with high sugar in the warmer parts of the State. While this is a great advantage in the fermentation and handling of the wine when made dry, it detracts from its value when made into a sweet wine. The sweet wines which we have made from it are harsh and lacking in quality. At best they are but neutral blending wines.

TABLE OF PRODUCTION.

WEST'S WHITE PROLIFIC.	Number of Vines	Total Weight of Grapes, in lbs.	Average per Vine, in lbs.	Date of Picking
1887—No. 695 (long-pruned). J. T. Doyle, Cupertino	20	332	16.6	Oct. 5
No. 749 (short-pruned). J. T. Doyle, Cupertino	20	100	5.0	Oct. 18
1888—No. 942 (short-pruned). J. T. Doyle, Cupertino	18	395	21.9	Oct. 25
No. 943 (long-pruned). J. T. Doyle, Cupertino	20	430	21.5	Oct. 25
1889—No. 1154. J. T. Doyle, Cupertino	20	550	27.5	Oct. 9

Analyses of Musts and Wines.

WEST'S WHITE PROLIFIC.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six to Eight Months	Volatile Acid	Body	Sugar
						By Weight	By Volume				
1886—No. 500. J. T. Doyle, Cupertino	Sept. 27	20.00	18.89	1.00	.26	7.50	9.36	.77		2.35	
No. 505. J. T. Doyle, Cupertino	Sept. 27	19.80		.91		7.71	9.65	.69		2.05	
1887—No. 695 (long-pruned). J. T. Doyle, Cupertino	Oct. 5	23.69	24.01	.78	.27	9.05	11.27	.54	.15	2.60	
No. 749 (short-pruned). J. T. Doyle, Cupertino	Oct. 18	26.16	25.19	.66	.44	10.35	12.82	.48	.10	2.60	
1888—No. 942 (short-pruned). J. T. Doyle, Cupertino	Oct. 25	25.95	26.99	.48	.37	10.35	12.80	.46			
No. 943 (long-pruned). J. T. Doyle, Cupertino	Oct. 25	25.02	25.76	.60	.28						
1889—No. 1045. Margherita Vineyard, Fresno	Sept. 2	28.30	28.07	.43	.49						
No. 1154. J. T. Doyle, Cupertino	Oct. 9	25.90		.65							
1890—No. 1238. Margherita Vineyard, Fresno	Aug. 22	25.20	25.76	.57	.31						
No. 1271. J. T. Doyle, Cupertino	Sept. 29	20.60		.86	.31						
1891—No. 1465. Fresno	Aug. 28	25.65		.56		*15.25	18.78	.33		2.85	
No. 1531. Paso Robles	Oct. 6	24.60		.54							
1892—No. 1640. Tulare	Sept. 12	24.35	23.23	.62	.50	*14.82	18.25	.52		2.70	1.50
No. 1754. Paso Robles	Oct. 11	24.10		.57							
1893—No. 1872. Amador station	Sept. 16	22.20		1.03							
No. 1903. Tulare	Oct. 1	22.40	20.99	.77	.47	8.70	10.83	.44		2.60	
No. 1903*a*. Tulare	Oct. 1						16.20	.68		2.82	.98
No. 2034. Cupertino	Nov. 1	21.50		.92							
No. 2069. Paso Robles	Nov. 1	25.45	24.64	.58	.32		19.35	.47		2.85	
1894—No. 2186. Amador station	Sept. 25	25.90		.70							
No. 2221. Tulare	Oct. 1	24.80	22.67	.76							
No. 2222. Amador station	Oct. 1	27.60		.53							

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*Fortified.

RECORD OF TREATMENT.

No. 695. *West's White Prolific*, from Cupertino. Received October 6, 1887, in good condition, and crushed the following day. The bunches were long, loose, and slender, very little affected by coulure; the berries were greenish, bronzed like the Palomino where exposed to the sun. The must showed 23.69% of solid contents by spindle and 0.78% of acid. Fermentation commenced the day of crushing, and reached its maximum temperature of 89°, on the second day. The 110.7 lbs. crushed yielded 8.7 gals., or at the rate of 156 gals. per ton.

At three weeks the wine was drawn off the thick lees. At two months it was bright, thin-bodied, and with high acid; it had less bouquet than No. 749, the sample from short-pruned vines. A microscopic examination of the lees showed acetic germs; the wine was racked again and pasteurized. At seven months it had improved very much, was heavy-bodied, clean-tasting, with pleasant Sherry flavor and well-developed bouquet. At fifteen months it was distilled for brandy.

No. 749. *West's White Prolific*, from Cupertino. Received October 19, 1887, in good condition, and crushed the day of arrival. The bunches were generally well filled, but a few showed a little early coulure; the berries were good and of full size, except for a few abortive ones. The must showed 26.16% of solid contents by spindle and 0.66% of acid. The fermentation reached its maximum on the third day at a temperature of 83°. The yield from 83 lbs. was 6.0 gals., or at the rate of 165 gals. per ton.

In two weeks the wine was drawn off the thick lees and divided into two packages: one of four gallons for dry wine, and the other of two gallons for Sherry. To the latter was added sufficient alcohol to bring it up to 18%, and the sample was put into the heating-chamber, at a temperature of 80°. In two months No. 749 (dry wine) was in good condition, bright, with medium acid and some bouquet. A month later it was racked and pasteurized. At eight months it was a very good wine with low acid, marked flavor, and well-developed bouquet—a promising wine for distillation. At fifteen months it was distilled for brandy. At four months No. 749*a* (Sherry sample) had improved very much. At eight months it was in good order and possessed a good Sherry aroma, but was quite dry. It was sweetened to 5% by the addition of rock-candy. The wine improved and made a good Sherry, but was somewhat deficient in alcohol.

No. 942. *West's White Prolific*, from Cupertino. Received October 26, 1888, in good condition. The grapes were from both long and short-pruned vines, the former looking the best. A few berries were dried up, but they were not generally overripe. The effect of a little coulure was noticeable. The must showed 25.95% of solid contents by spindle and 0.48% of acid. The grapes were crushed the day they arrived, and yielded must at the rate of 159 gals. per ton.

At one month the wine was racked and taken to the cellar. At three months it was clear, good, with pleasing aroma and advanced development. Two months later it was racked again. The lees were examined microscopically at five, sixteen, and twenty-one months, respectively, and no unsound ferments found. At fifteen months the wine was bright, with full and agreeable bouquet and well-developed flavor, but not yet bottle-ripe. At seventeen months it was racked again. At twenty-one months it was bright and good and nearly mature. A month later it was bottled. At two years and five months some wine that had been bottled at five months was examined; it was bright, smooth, and clean-tasting, with full flavor and some bouquet. That bottled at twenty-two months was little different, but with a little less flavor. Eighteen months later the earlier bottled wine had deteriorated, while the later had improved and was very good. At seven years the second bottling was a smooth, pleasing wine, with little bouquet or character.

No. 1045. *West's White Prolific*, from Fresno. A sample for must analysis was received September 5, 1889. The bunches were of medium size or larger, cylindrical, sometimes shouldered; the berries medium sized, firm, and juicy. The must showed 28.3% of solid contents by spindle and 0.43% of acid.

No. 1154. *West's White Prolific*, from Cupertino. A sample for must analysis was received October 10, 1889, in good condition, and mature. The bunches were large, not very compact, cylindrical, and sometimes shouldered. The must showed 25.9% of solid contents by spindle and 0.65% of acid.

No. 1238. *West's White Prolific*, from Fresno. A sample for must analysis was received August 25, 1890, in good condition, but many of the berries dried. The must showed 25.2% of solid contents by spindle and 0.57% of acid.

No. 1271. *West's White Prolific*, from Cupertino. A sample for must analysis was received October 2, 1890, in good condition, but small, tasteless, and unripe. The must showed 20.6% of solid contents by spindle and 0.86% of acid.

No. 1465. *West's White Prolific*, from Fresno. Received August 31, 1891, in good condition. The must showed 25.65% of solid contents by spindle and 0.56% of acid. The temperature of the grapes at crushing was 70°, and the maximum reached was 74°, on the fourth day. The fermentation was very slow, and on the eighth day was stopped by the addition of spirits.

At four months the wine was bright, with good aroma, and slight sweetness. The next month it was racked for the second time, and at six months put in the hot-box, at a temperature of from 90° to 95°, for three months. At two years and ten months it was a fair but coarse Sherry, without much flavor or aroma. Four months later it had improved, and was put in glass and loosely corked. At four years and five months it was a coarse Sherry that would be useful as a blend with a smooth, full-flavored wine. It had acquired a very marked "rancio" taste.

No. 1531. *West's White Prolific*, from Paso Robles station. A sample for must analysis was received October 8, 1891, in good condition. The bunches were small and compact; the berries small, round-oval, mature. The must showed 24.6% of solid contents by spindle and 0.54% of acid.

No. 1640. *West's White Prolific*, from Tulare station. Received September 15, 1892, in good condition. The must showed 24.35% of solid contents by spindle and 0.62% of acid. The temperature of the grapes at crushing was 64°, and the maximum reached was 77°, on the fourth day. The wine was fortified on the fifth day.

In one month the wine was clear and was racked. At three months it was bright and promising, with low acid and slight sweetness. At six months it was refortified and sweetened by the addition of a little rock-candy, racked, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At ten months it was bright, clean-tasting, and neutral. At two years and three months the wine was in good order—a good, clean-tasting, rather thin wine, with little character, but without any positive defects. Blended with one quarter of No. 1619 (Marsanne) it made a good Sherry. At three years and five months it had improved, showed good flavor and aroma, but was rather too high in acid and lacked smoothness.

No. 1754. *West's White Prolific*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 24.1% of solid contents by spindle and 0.57% of acid.

No. 1872. *West's White Prolific*, from Amador station. A sample for must analysis was received September 16, 1893, in good condition, but not mature. The bunches were small, the berries of medium size. There was evidence of some coulure. The must showed 22.2% of solid contents by spindle and 1.03% of acid.

No. 1903. *West's White Prolific*, from Tulare station. Received October 2, 1893, in good condition, and nearly mature, but with a good deal of acid. The bunches were small and rather loose, the berries of medium size. The must showed 22.4% of solid contents by spindle and 0.77% of acid. The temperature of the grapes at crushing was 70°, and the maximum reached was 87°, on the third day. On the fifth day the wine was still a little sweet, and five gallons were drawn off and fortified. The rest was fermented out dry.

No. 1903 (dry wine). In five weeks the wine was clear and clean-tasting. It was racked and taken to the cellar. At four months it was bright, with little flavor, no aroma, and a slight bitterness. A month later it was racked again, and at six months it showed no improvement; it was flat and without character. At ten months it was no better, and the lees showed some acetic germs; it was racked again and part put in bottle. At thirteen months it was slightly better; it had more body and less acid than the Burger from Tulare, but was inferior to the latter in quality. At nineteen months it was bottled. At two years and four months it was bright and without deposit, lacking in bouquet and flavor, but sound and fairly agreeable.

No. 1903*a* (fortified). At two months it was bright, but too dry. It was racked for the second time, and at five months put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At nine months it was racked again, and at two years and four months it was in good order, but a dry and tasteless wine of poor quality.

No. 2034. *West's White Prolific*, from Cupertino. A sample for must analysis was received October 31, 1893, in good condition, but not quite mature. The bunches were of medium size, long, conico-cylindrical, close to compact; the berries of medium size, juicy, thin-skinned, and with full acid. The must showed 21.5% of solid contents by spindle and 0.92% of acid.

No. 2069. *West's White Prolific*, from Paso Robles station. Received November 3, 1893, in fair condition. The bunches were small to medium, well filled, conico-cylindrical, with or without shoulders, sometimes branching; the berries under medium in size, slightly oval, soft and juicy, not quite mature. The must showed 25.45% of solid contents by spindle and 0.58% of acid. The temperature of the grapes at crushing was 69°, and the maximum reached was 78°, on the third day. On the eighth day the wine was fortified.

In five weeks the wine was bright, but too dry. It was racked for the second time, and at four months was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At eight months it was racked again. At fifteen months it was in good order, rather too dry, of fair aroma and some Sherry taste, but lacking in delicacy and smoothness.

FEHER SZAGOS.

This variety, like the West's White Prolific, was imported from Europe and the name lost. It was presumed, for some reason, to be a Hungarian grape, and in California was given its present name, which is the Hungarian for white grape.

Description.—Vine strong-growing in rich soils, and very productive; leaves small to medium, roundish, generally three-lobed, and with shallow sinuses, glabrous above and nearly so beneath; bunches large, long, and narrow; berries oblong, pendent, loosely placed on long pedicels; skin thin and tender, covered with brown dots; flesh firm.

This vine is an extremely heavy bearer at Fresno with short-pruning. The grapes attain a good percentage of sugar when the crop is not too large, and are low in acid. They have, however, very little character, and make at best a neutral, cutting Sherry. Their lack of acid and character makes them quite unsuited to the production of dry wine.

The fermentation is remarkably slow and steady, but shows little tendency to "go wrong."

ANALYSES OF MUSTS AND WINES.

FEHER SZAGOS.	Date of Picking	MUST.				WINE.						
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Volatile Acid	Body	Ash	Sugar
1881—No. 24. G. Eisen, Fresno	------	17.15	19.54	.32	------	8.54	8.22	.56	------	1.68	.39	------
No. 25 G. Eisen, Fresno	------	17.15	19.54	.32	------	10.60	10.20	.53	------	1.99	.44	------
1887—No. 798.† Margherita Vineyard, Fresno	Nov. 11	26.81	26.99	.17	.68	7.78	9.73	.77	.36	------	------	------
1890—No. 1213. Margherita Vineyard, Fresno	Aug. 22	22.40	21.97	.40	.40	------	------	------	------	------	------	------
1891—No. 1503. Fresno	Sept. 20	23.70	23.62	.32	------	*15.50	19.08	.39	------	2.38	------	1.42

*Fortified. †Overripe.

RECORD OF TREATMENT.

No. 798. *Feher Szagos*, from Fresno. Received November 14, 1887, in fair condition, overripe and flabby, but generally sound. The bunches were long and narrow, occasionally shouldered; the berries were large, oblong, pendent, loosely placed on long pedicels; the skin was thin and tender, covered with brown dots; the flesh was solid and gelatinous. About 15% of the grapes were half-raisins; they tasted very astringent for a white grape. The must showed 26.81% of solid contents by spindle and 0.17% of acid. The grapes (125 lbs.) were thoroughly crushed and the mash aërated from time to time for twenty-four hours, when it was pressed. On the second day after crushing the fermentation was so slow that the must was put in the heating-chamber, at a temperature of 85°. It fermented slowly and its temperature did not rise above the temperature of the room.

At one month the wine was drawn off the thick lees and left in the hot chamber. At two months wine-flowers appeared and the wine had a slight acetic smell, so it was drawn off and pasteurized. At this date it had 9% of solid contents and it was fortified up to 18% of alcohol. A month later it was bright and improved, but quite neutral and too sweet. At eight months it was in good order and had improved in bouquet and in quality generally.

No. 1213. *Feher Szagos*, from Fresno. A sample for must analysis was received August 25, 1890, in poor condition. The grapes were quite ripe, and the must showed 22.4% of solid contents by spindle and 0.40% of acid.

No. 1503. *Feher Szagos*, from Fresno. Received September 25, 1891, in good condition. The must showed 23.7% of solid contents by spindle and 0.32% of acid. The temperature of the grapes at crushing was 70°, and the maximum reached was 77°, on the third day. The fermentation was very slow, and it was not till the eighteenth day that the wine was dry enough to fortify.

At three months the wine was clear, fresh, and clean-tasting, with rather high sweetness. At five months it was racked for the third time, and at six months put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years and ten months it was bright, a perfectly neutral wine, without positive defects, but lacking altogether in flavor and aroma. It would make an excellent neutral blend with some highly flavored Sherry. Four months later it was put in glass; it was very clean-tasting, but without character. At four years and five months it was well advanced toward maturity, was smooth and clean-tasting, but showed little flavor or aroma.

MUSCATEL.

(See Vit. Rept. 1885, p. 103.)

Synonyms: Muscat blanc de Frontignan; White Frontignan; Muskateller; Weisse Muscattraube; Moscatello bianco.

Description.—Vine of medium size, with strong, spreading canes; canes reddish-brown, with short internodes; leaves of medium size, thin, five-lobed, glabrous, except for a few hairs on the lower side of the well-marked ribs; bunches long, cylindrical, regular, compact; berries round, golden-yellow, becoming amber-colored, very sweet and of marked aroma. Ripens a little later than the Chasselas.

The Muscatel in some one of its many forms is cultivated in almost every country where vines are grown. It is highly esteemed as an early table-grape wherever its poor shipping qualities do not preclude its use; several forms, such as Silver Frontignan, Auvergne Frontignan, Grisely Frontignan, are grown in English hothouses. The Muskateller is grown widely, but not in large quantities, all over Austria, Hungary, and parts of Germany, where it is used principally as an addition to neutral grapes lacking in aroma. In Italy several yellowish and pinkish variations are grown. In southern countries the berries are larger, but the aroma is less marked than in cooler climates. The principal importance of the Muscatel comes from the fact that from it are made the famous "vins de liqueur" of Frontignan in southern France. In making these wines the grapes are allowed to remain on the vines till they have reached the last stages of ripening or even have become half-raisins. These wines are held in such high esteem that it is worth while to attempt to reproduce them in California. In fact, some very creditable sweet Muscatel has already been made here, but it must be kept in mind that only from grapes grown on dry hillsides and allowed to reach the last stages of maturity can anything approaching the wines of Frontignan be made.

The Muscatel should not be planted in situations liable to spring frosts, on account of the early starting of the buds. Like many varieties of ancient origin, it is liable to degenerate and give rise to sports that produce abortive berries without seeds and about the size of peas. On this account great care should be exercised in the choice of cuttings. On account of the peculiar attractive aroma of this grape it is more subject to the attacks of animals and insects than any other. Deer and rabbits will single out a vine of this variety from a whole vineyard for their attacks. Insects are so partial to the grapes that the Romans, who had several varieties of Muscat, called them "Apianæ," from "apis," a bee. Our modern name of Muscat has a similar signification, being derived from the Latin "musca," a fly.

Though the Muscat flavor is in such high repute for "vins de liqueur" in Europe, it seems somewhat discredited in California. This is doubtless due to the use of the Muscat of Alexandria, which is much inferior to the Muscatel for this purpose. The natural aroma of all grapes is strongest in the wine when it is new, and in time becomes feebler, and at last is completely lost. The Muscatel has the most pronounced and the most persistent of all grape aromas, and the wine does not completely lose it for twelve or more years. As the natural aroma disappears, the wine acquires a "gout de rance," which is very delicate and agreeable.

ANALYSES OF MUSTS.

MUSCATEL.	Date of Picking	MUST.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash
1889—No. 1024. Fresno	Aug. 31	25.00	25.19	.42	.47
1890—No. 1215. Fresno	Aug. 23	23.30	23.13	.41	.34
1893—No. 1963. Paso Robles	Oct. 12	29.65	--------	.34	------
No. 1998. Tulare	Oct. 17	26.95	--------	.47	------

RECORD OF TREATMENT.

No. 1024. *Early Silver Frontignan*, from Margherita Vineyard, Fresno. Grapes arrived September 2, 1889, in fair condition, but only in small quantity for must analysis. Bunches large, pyramidal, and winged; grapes medium size, close, round, and golden-green colored; flesh soft, with a strong Muscat flavor; skin thin and easily broken. Juice showed 25.0% of solid contents and 0.42% of acid.

No. 1215. *Early Silver Frontignan*, from Fresno. A sample for must analysis was received August 25, 1890, in bruised condition. The grapes were very ripe, but only showed 23.3% of solid contents by spindle and 0.41% of acid.

No. 1963. *Muscatel*, from Paso Robles station. A sample for must analysis was received October 14, 1893, in good condition. The bunches were of medium size, close, cylindrical, with or without a small shoulder or wing; the berries were round, of medium size, overripe, commencing to dry up. The grapes were from long-pruned vines growing in sandy soil and bearing a very small crop—about one and a half tons per acre. The must showed 29.65% of solid contents and 0.34% of acid.

No. 1998. *Muscatel*, from Tulare station. A sample for must analysis was received October 19, 1893, in good condition. The grapes were a mixture of first and second crop. The first was overripe and dried up, while the second was not quite ripe. The must showed 26.95% of solid contents by spindle and 0.47% of acid.

MALVASIA BIANCA.

Synonym: Malvoisie blanche du Piedmont.

Description.—Vine fairly vigorous, with light-brown wood; leaves three-lobed, with shallow sinuses, glabrous above, woolly beneath, with short, sharp teeth; bunches over average in size, conico-cylindrical, winged, well filled but not compressed, on long, thin peduncles; berries round, small to average in size, with thick, tough skin and light bloom, color green, with a pinkish tint on the ripest grapes, flesh soft and juicy, with a delicate Muscat aroma.

This variety is widely cultivated in Piedmont and is used for the production of sweet wines and "vins de liqueur." At Asti, Italy, it is employed to some extent in the production of sparkling wines. It is an agreeable eating-grape with a delicate Muscat flavor, but is too soft and juicy to be grown extensively for this purpose.

Analyses of Musts.

MALVASIA BIANCA.	Date of Picking	Solid Contents by Spindle	Acid as Tartaric
1890—No. 1360. Cupertino	Oct. 17	26.10	.65
1891—No. 1532. Paso Robles	Oct. 6	26.95	.31
1892—No. 1756. Paso Robles	Oct. 11	26.50	.24
1893—No. 2105. Cupertino	Nov. 5	25.90	.74

Record of Treatment.

No. 1360. *Malvasia bianca*, from Cupertino. Received October 17, 1890, in good condition, but rather softened by the rain. The bunches were over average in size, conico-cylindrical, well filled, but not compressed; the berries were round, small to average, on long, thick pedicels; the skin was thick, tough, with a light bloom and of a pinkish color. The must showed 26.1% of solid contents by spindle and 0.65% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 79°, on the fourth day. On the seventh day the wine was dry and was racked off.

At one month the wine was bright, of slightly pinkish tint, strong aroma, full flavor, clean taste, medium acid, and, in general, of good quality. A month later it was racked for the second time. At two and at three months the lees were examined and no unsound germs found. At three months the wine was still in good condition; it was racked for the third time; it was full-bodied and with high alcohol, but still tasted raw. Two months later the lees showed some unsound germs and the wine was pasteurized. At seven months it was bright, maturing well, with strong flavor and aroma. At fifteen months it was bright, with rich Muscat aroma, fresh and clean taste, nearly mature. Eight months later it was bottled. At three years the bottled wine had deteriorated and made a heavy deposit in bottle; it had been bottled too soon.

No. 1532. *Malvasia bianca*, from Paso Robles. A sample for must analysis was received October 8, 1891, in fair condition, but a little moldy. The bunches and grapes were of average size; the berries thin-skinned and tender. The grapes were mature, and the must showed 26.95% of solid contents by spindle and 0.31% of acid.

No. 1756. *Malvasia bianca*, from Paso Robles. A sample for must analysis was received October 13, 1892, in good condition. The must showed 26.5% of solid contents by spindle and 0.24% of acid.

No. 2105. *Malvasia bianca*, from Cupertino. A sample for must analysis was received November 7, 1893, in good condition. The bunches were of medium size, conico-cylindrical, slightly shouldered; the berries of medium size, soft, juicy, with thick skins, and a delicate Muscat aroma. The must showed 25.9% of solid contents by spindle and 0.74% of acid.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF SHERRY AND MADEIRA TYPE.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at 6 to 8 Months	Body
	Pedro Jimenes.								
266	Natoma	1884	20.78	20.61	.33	.40	12.00	.56	1.18
484	Natoma	1886	19.30	18.89	.38	.35	9.73	.59	2.00
784	Cupertino	1887	21.26	20.61	.45	.40	9.36	.68	2.30
953	Cupertino	1888	19.40	19.89	.35	.48	9.54	.36	2.40
1191	Cupertino	1889	20.06	------	.25	.41	*17.70	.21	4.00
1404	Cupertino	1890	19.70	------	.47	.23	*17.20	.33	2.08
2036	Cupertino	1893	23.70	------	.47	------	------	------	------
1244	Fresno	1890	21.20	20.39	.41	.61	*20.06	.30	2.77
1502	Fresno	1891	23.70	23.13	.45	------	*19.08	.30	2.61
1502a	Fresno	1891	23.70	23.13	.45	------	*20.06	.27	------
1352	Mission San José	1890	22.30	------	.42	------	*17.40	.34	2.48
1606	Mission San José	1891	24.80	------	.49	.37	*21.19	.20	3.31
1779	Mission San José	1892	23.15	22.67	.50	------	11.55	.53	2.60
2246	Mission San José	1894	22.30	------	.42	------	------	------	------
1670	Tulare	1892	22.60	21.38	.33	.47	*18.25	.38	2.55
1900	Tulare	1893	22.20	21.80	.41	.43	------	------	------
2350	Tulare	1894	23.90	------	.29	------	------	------	------
1853	Amador station	1893	19.30	------	.53	------	------	------	------
2164	Amador station	1894	21.50	------	.58	------	------	------	------
1916	Paso Robles	1893	21.50	21.00	.40	.38	*18.25	.35	2.85
2214	Paso Robles	1894	21.50	------	.49	------	------	------	------
	Average, Natoma	------	**20.04**	**19.75**	**.36**	**.38**	**10.86**	**.58**	**1.59**
	Average, Cupertino	------	**20.82**	**20.25**	**40**	**.38**	**9.45**	**.52**	**2.35**
	Average, Fresno	------	**22.87**	**22.22**	**.43**	**.61**	------	**.27**	------
	Average, Mission San Jose	------	**23 14**	**22.67**	**.46**	**.37**	------	**.36**	------
	Average, Tulare	------	**22.90**	**21.59**	**.34**	**.45**	------	**.38**	------
	Average, Amador station	------	**20.40**	------	**.56**	------	------	------	------
	Average, Paso Robles	------	**21.50**	**21.00**	**.45**	**.38**	------	**.35**	------
	Palomino.								
504	Cupertino	1886	16.30	15.68	.53	.27	8.00	.59	1.55
765	Cupertino. (Long-pruned)	1887	23.09	22.67	.42	.44	12.18	.44	2.60
698	Cupertino. (Long-pruned)	1887	19.57	19.75	.37	.38	9.36	.49	2.10
728	Cupertino. (Short-pruned)	1887	23.30	22.67	.47	.37	12.09	.47	2.60
952	Cupertino	1888	21.57	22.67	.18	.36	10.91	.52	2.05
951	Cupertino	1888	21.39	21.80	.24	.34	10.36	.42	2.30
1198	Cupertino	1889	23.70	23.13	.22	.42	11.27	.39	1.95
1311	Cupertino	1890	20.85	------	.43	.27	11.73	.38	2.10
1397	Cupertino	1890	24.60	------	.31	------	------	------	------
2067	Cupertino	1893	24.80	------	.47	------	------	------	------
547	Mission San José	1886	23.70	------	.55	------	------	------	------
727	Mission San José. (Long pruned)	1887	22.00	20.85	.35	.40	11.09	.47	2.40
1171	Mission San José	1889	23.05	23.13	.38	.33	*19.00	.32	3.01
1423	Mission San José	1890	28.00	------	.34	------	------	------	-----
1519	Mission San José	1891	25.45	------	.53	------	------	------	------
1780	Mission San José	1892	20.50	19.75	.55	------	10.25	.59	2.55
2019	Mission San José	1893	22.90	21.38	.61	.35	*17.70	.48	4.30
2251	Mission San José	1894	22.40	------	.41	------	------	------	------
267	Natoma	1884	23.86	23.81	.32	.40	13.50	.53	1.85
384	San José	1885	------	------	------	------	13.00	.57	2.18
683	Livermore	1887	22.60	22.58	.38	.40	11.36	.47	2.40
1041	Fresno	1889	25.00	25.19	.18	.65	*17.20	.44	2.35
1239	Fresno	1890	23.92	23.42	.34	.33	*18.25	.25	2.48
1476	Fresno	1891	24.10	23.62	.36	.48	*20.00	.11	2.45
1654	Paso Robles	1892	21.30	20.21	.39	.31	*19.28	.38	2.55
1671	Tulare	1892	23.70	22.67	.32	.48	*18.98	.37	2.55
1843	Tulare	1893	21.95	20.24	.38	.52	*18.88	.32	4.00

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* Fortified.

Summary of Analyses of Musts and Wines of Sherry and Madeira Type—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric.	Ash	Alcohol by Volume	Total Acid as Tartaric, at 6 to 8 Months	Body
	Palomino—Continued.								
1979	Tulare	1893	23.70	22.23	.26	.39	------	------	------
2154	Tulare	1894	24.00	------	.28	------	------	------	------
2292	Tulare	1894	24.60	24.01	.26	------	------	------	------
1875	Amador station	1893	20.60	------	.47	------	------	------	------
2165	Amador station	1894	24.05	22.67	.44	------	------	------	------
2166	Amador station	1894	24.40	23.13	.38	------	------	------	------
	Average, Cupertino	------	**21.92**	**21.19**	**.36**	**.36**	**10.74**	**.46**	**2.16**
	Average, Mission San Jose	------	**11.00**	**21.28**	**.46**	**.36**	**10.67**	**.53**	**2.47**
	Average, Fresno	------	**24.34**	**24.08**	**.29**	**.49**	------	------	------
	Average, Tulare	------	**23.59**	**22.29**	**.30**	**.46**	------	------	------
	Average, Amador station	------	**23.02**	**22.90**	**.43**	------	------	------	------
	Beba.								
271	Natoma	1884	22.60	------	.25	------	14.27	.50	2.10
1676	Tulare	1892	23.70	------	.26	------	*19.18	.38	2.92
1816	Tulare	1893	21.05	20.61	.38	.67	*17.20	.41	2.90
2169	Tulare	1894	24.80	24.12	.26	------	------	------	------
1854	Amador station	1893	22.60	------	.47	------	------	------	------
2163	Amador station	1894	25.20	------	.38	------	------	------	------
1965	Paso Robles	1893	27.21	------	.29	------	------	------	------
	Average, Tulare	------	**23.18**	**22.37**	**.30**	**.67**	***18.19**	**.40**	**2.91**
	Average, Amador station	------	**23.90**	------	**.43**	------	------	------	------
	Perruno.								
268	Natoma	1884	22.76	------	.31	.31	12.35	.52	1.95
1687	Tulare	1892	22.60	22.23	.29	.40	*19.96	.28	2.48
1905	Tulare	1893	22.20	20.61	.41	.34	*19.00	.48	2.88
2289	Tulare	1894	22.85	22.04	.35	------	------	------	------
1874	Amador station	1893	18.40	------	.51	------	------	------	------
2184	Amador station	1894	24.10	------	.39	------	------	------	------
1958	Paso Robles	1893	26.30	------	.15	------	------	------	------
	Average, Tulare	------	**22.55**	**21.63**	**.35**	**.37**	***19.48**	**.38**	**2.65**
	Average, Amador station	------	**21.25**	------	**.45**	------	------	------	------
	Mantuo de Pilas.								
269	Natoma	1884	18.63	------	.35	------	9.82	.53	1.32
477	Natoma	1885	20.40	20.02	.37	.42	9.73	.45	------
497	Natoma	1885	20.40	------	.28	------	10.58	.35	------
1688	Tulare	1892	23.50	23.42	.37	.58	*18.03	.31	2.53
1966	Tulare	1893	21.50	20.17	.38	.48	*17.50	.35	3.30
2332	Tulare	1894	23.30	22.23	.32	------	------	------	------
1877	Amador station	1893	19.30	------	.50	------	------	------	------
2182	Amador station	1894	22.10	------	.40	------	------	------	------
1957	Paso Robles	1893	22.75	------	.30	------	------	------	------
	Average, Natoma	------	**19.81**	**20.02**	**.47**	**.42**	**10.06**	**.44**	**1.32**
	Average, Tulare	------	**22.77**	**21.94**	**.36**	**.43**	------	------	------
	Average, Amador station	------	**20.70**	------	**.45**	------	------	------	------
	Mourisco branco.								
270	Natoma	1884	22.60	------	.25	------	14.27	.50	2.10
482	Natoma	1885	25.10	24.97	.31	.40	12.54	.33	------
1716	Tulare	1892	23.40	------	.33	------	------	------	------
1970	Tulare	1893	23.50	21.80	.32	.34	*19.08	.30	3.10
2312	Tulare	1894	22.60	------	.30	------	------	------	------
1876	Amador station	1893	18.20	------	.60	------	------	------	------
2183	Amador station	1894	20.00	------	.49	------	------	------	------
	Average, Natoma	------	**23.85**	**24.97**	**.28**	**.40**	**13.40**	**.42**	**2.10**
	Average, Tulare	------	**23.17**	**21.80**	**.32**	**.34**	------	------	------
	Average, Amador station	------	**19.10**	------	**.54**	------	------	------	------

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*Fortified.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF SHERRY AND MADEIRA TYPE—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at 6 to 8 Months	Body
	Verdelho.								
272	Natoma	1884	27.35	25.88	.50	.37	*15.20	.42	2.82
568	Mission San José	1886	25.90	------	1.00	------	------	------	------
838	Mission San José	1888	26.42	------	.57	------	------	------	------
914	Mission San José	1888	28.22	------	.34	.32	*15.20	.41	2.95
1297	Mission San José	1890	25.90	------	.71	.22	*16.98	.72	3.06
1518	Mission San José	1891	26.05	26 99	.71	------	*19.78	.51	3.80
2013	Mission San José	1893	28.40	27.70	.55	.30	------	------	------
2249	Mission San José	1894	24.60	------	.55	------	------	------	------
766	Cupertino	1887	30.04	31.48	.49	.45	------	------	------
867	Cupertino	1888	24.15	24.33	.46	.26	12.27	.64	2.70
1100	Cupertino	1889	26.90	26.99	.54	.40	13.27	.44	2.86
1322	Cupertino	1890	27.65	------	.55	------	------	------	------
2102	Cupertino	1893	27.70	------	.44	------	------	------	------
1203	Fresno	1890	24.10	24.64	.65	.52	*18.22	.55	2.96
1466	Fresno	1891	29.10	------	.54	------	*20.71	.45	2.99
1451	Tulare	1891	26.30	------	.56	------	------	------	------
1699	Tulare	1892	25.90	27.65	.49	------	*20.24	.36	2.95
1904	Tulare	1893	25.75	25.76	.58	.43	*19.90	.53	3.10
2220	Tulare	1894	27.15	26.31	.49	------	------	------	------
1485	Paso Robles	1891	24.10	------	.55	------	------	------	------
2219	Paso Robles	1894	26.06	------	.66	------	------	------	------
1859	Amador station	1893	26.10	------	.63	------	------	------	------
2180	Amador station	1894	27.35	------	.45	------	------	------	------
	Average, Mission San Jose	------	**26.49**	**27.34**	**.57**	**.28**	------	------	------
	Average, Cupertino	------	**27.29**	**27.60**	**.49**	**.37**	**12.77**	**.54**	**2.78**
	Average, Fresno	------	**27.43**	**24.64**	**.58**	**.52**	------	------	------
	Average, Tulare	------	**26.27**	**26.57**	**.53**	**.43**	------	------	------
	Average, Paso Robles	------	**25.08**	------	**.60**	------	------	------	------
	Average, Amador station	------	**26.72**	------	**.54**	------	------	------	------
	Boal de Madeira.								
273	Natoma	1884	21.76	------	.53	------	11.58	.66	2.00
1085	Mission San José	1889	26.30	26.12	.62	.38	12.91	.48	2.30
1300	Mission San José	1890	25.00	------	.57	.31	*17.00	.30	3.14
1570	Mission San José	1891	26.90	------	.57	------	------	------	------
1951	Mission San José	1893	24.80	------	.90	------	------	------	------
2248	Mission San José	1894	23.70	------	.48	------	------	------	------
1393	Cupertino	1890	27.15	------	.48	------	------	------	------
2095	Cupertino	1893	28.40	------	.45	------	------	------	------
1473	Fresno	1891	26.30	------	.50	.36	*21.19	.41	3.09
1873	Amador station	1893	25.60	------	.53	------	------	------	------
2140	Amador station	1894	29.55	------	.37	------	------	------	------
1962	Paso Robles	1893	26.50	------	.34	------	------	------	------
2213	Paso Robles	1894	28.60	------	.45	------	------	------	------
2331	Tulare	1894	25.20	------	.40	------	------	------	------
	Average, Cupertino	------	**25.34**	**26.12**	**.65**	**.35**	**12.91**	**.48**	**2.30**
	Average, Mission San Jose	------	**27.78**	------	**.47**	------	------	------	------
	Average, Amador station	------	**27.58**	------	**.45**	------	------	------	------
	Average, Paso Robles	------	**27.55**	------	**.40**	------	------	------	------
	Malmsey.								
275	Natoma	1884	17.91	------	.56	------	9.91	.54	1.60
1698	Tulare	1892	22.40	------	.47	------	------	------	------
1901	Tulare	1893	20.60	------	.45	.38	------	------	------
2286	Tulare	1894	23.15	21 80	.34	------	------	------	------
1959	Paso Robles	1893	25 90	------	.33	------	------	------	------
	Average, Tulare	------	**22.05**	**21.80**	**.42**	------	------	------	------

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*Fortified.

Summary of Analyses of Musts and Wines of Sherry and Madeira Type—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric.	Ash	Alcohol by Volume	Total Acid as Tartaric, at 6 to 8 Months	Body
	West's White Prolific.								
500	Cupertino	1886	20.00	18.89	1.00	.26	9.36	.77	2.35
505	Cupertino	1886	19.80	------	.91	------	9.65	.69	2.05
695	Cupertino. (Long-pruned)	1887	23.69	24.01	.78	.27	11.27	.54	2.60
749	Cupertino. (Short-pruned)	1887	26.16	25.19	.66	.44	12.82	.48	2.60
942	Cupertino. (Short-pruned)	1888	25.95	26.99	.48	.37	12.80	.46	
943	Cupertino. (Long-pruned)	1888	25.02	25.76	.60	.28			------
1154	Cupertino	1889	25.90	------	.65	------	------	------	------
1271	Cupertino	1890	20.60	------	.86	.31	------	------	------
2034	Cupertino	1893	21.50	------	.92	------	------	------	------
1045	Fresno	1889	28.30	28.07	.43	.49	------	------	------
1238	Fresno	1890	25.20	25.76	.57	.31	------	------	------
1465	Fresno	1891	25.65	------	.56	------	*18.78	.33	2.85
1531	Paso Robles	1891	24.60	------	.54	------	------	------	------
1754	Paso Robles	1892	24.10	------	.57	------	------	------	------
2069	Paso Robles	1893	25.45	24.64	.58	.32	*19.35	.47	2.85
1640	Tulare	1892	24.35	23.23	.62	.50	*18.25	.52	2.70
1903	Tulare	1893	22.40	20.99	.77	.47	*10.83	.44	2.60
2221	Tulare	1894	24.80	22.67	.76	------	------	------	------
1872	Amador station	1893	22.20	------	1.03	------	------	------	------
2186	Amador station	1894	25.90	------	.70	------	------	------	------
2222	Amador station	1894	27.60	------	.53	------	------	------	------
	Average, Cupertino	------	**25.34**	**25.49**	**.63**	**.34**	**12.29**	**.49**	**2.60**
	Average, Fresno	------	**26.38**	**26.92**	**.52**	**.40**	------	------	------
	Average, Paso Robles	------	**24.72**	**24.64**	**.56**	**.32**	------	------	------
	Average, Tulare	------	**23.85**	**22.29**	**.72**	**.48**	------	------	------
	Average, Amador station	------	**26.75**	------	**.62**	------	------	------	------
	Feher Szagos.								
24	Fresno	1881	17.15	19.54	.32	------	8.22	.56	1.68
25	Fresno	1881	17.15	19.54	.32	------	10.20	.53	1.99
789	Fresno	1887	26.81	26.99	.17	.68	*9.73	.77	------
1213	Fresno	1890	22.40	21.97	.40	.40	------	------	------
1503	Fresno	1891	23.70	23.62	.32	------	*19.08	.39	2.38
	Average, Fresno	------	**21.44**	**22.33**	**.31**	**.54**	**9.21**	**.55**	**1.88**
	Muscatel.								
1024	Fresno	------	25.00	25.19	.42	.47	------	------	------
1215	Fresno	1889	23.30	23.13	.41	.34	------	------	------
1963	Paso Robles	1890	29.65	------	.34	------	------	------	------
1998	Tulare	1893	26.95	------	.47	------	------	------	------
	Average, Fresno	1893	**24.15**	**24.16**	**.41**	**.40**	------	------	------
	Malvasia bianca.								
1360	Cupertino	------	26.10	------	.65	------	------	------	------
2105	Cupertino	------	25.90	------	.74	------	------	------	------
1532	Paso Robles	1890	26.95	------	.31	------	------	------	------
1756	Paso Robles	1893	26.50	------	.24	------	------	------	------
	Average, Cupertino	1891	**26.00**	------	**.69**	------	------	------	------
	Average, Paso Robles	1892	**26.72**	------	**.28**	------	------	------	------

*Fortified.

C. RAISIN AND TABLE GRAPES.

The table-grapes included in this group are, for the most part, well known in California already. Some, such as the Pizzutello and Gros Colman, are worthy of being better known, for they are very showy and attractive, though unfitted for distant shipments, on account of their delicate skin. With different methods of packing and more careful handling, they could be made very profitable for local markets. The grape of Almeria has doubtless a future, for, as the experiments show, it is possible in some localities, by appropriate methods of pruning and training, to make it produce good crops, and it has probably no superior as a keeping grape.

Some of the Spanish Sherry grapes, such as the Mantuo, Beba, Perruno, and Mourisco, are very promising as table-grapes, and are also worthy of trial for the production of raisins. In southern Spain and Portugal very good lye-dipped raisins are made from these varieties, and their heavy bearing and freedom from coulure recommend them in spite of the superior quality of the Muscat of Alexandria. The raisin-grapes are considered in this report principally from the side of their utility as wine producers, though the analyses throw some light on their relative values for drying purposes.

RAISIN-GRAPES.

MUSCAT OF ALEXANDRIA.

(See Vit. Rept. 1885–86, p. 108.)

Description.—Vine small and not very vigorous, spreading in habit; canes short-jointed and of medium size; leaves medium size, round, generally five-lobed, the upper sinuses well marked and closed, the lower shallow and sometimes wanting, the petiolar sinus open, glabrous on both sides, and sharply toothed ; bunches large, winged, loose, sometimes branching; berries large, varying from nearly round to elliptical or obovoid, with thin but rather tough skin, firm, crisp flesh, and green to dull yellow color.

The synonymy of the Muscat is in a somewhat unsettled state. There is no doubt that there exist several forms in California which, by many observers, are classed together as Muscat of Alexandria. Whether these are simple variations due to climatic conditions and selection is impossible at present to say. The Gordo Blanco, which is held by many careful observers to be sufficiently distinct from the Muscat of Alexandria, is chiefly distinguished by the roundness of its berries. This seems hardly sufficient to base a variety on, in view of the fact that both obovoid and nearly round berries are found on the same bunch. The Huasco, which resembles the Gordo Blanco form in roundness of berries and the greater compactness of its bunches, seems also to differ in the greater prevalence of three-lobed leaves. The presence of three or five lobed leaves is, however, a variable characteristic in the Muscat. Nearly all varieties which, like the Muscat, are of ancient origin and wide distribution, exhibit similar variations, due generally to careful selection of cuttings. Whether or not these various forms are to be considered as true varieties, they are economically of great importance, as by proper selection the quality of the raisins of California can be improved, and the unfortunate liability of the Muscat to coulure may be overcome. At the Experiment Stations the Huasco form has shown considerable superiority in the matter of freedom from coulure; but its round berries and more compact bunches render it somewhat less adapted to the production of "gilt edge" bunch raisins.

As a wine-grape the Muscat of Alexandria is little used, except to make a little sweet "Muscat wine," and occasionally in small quantities, to add aroma to neutral grapes. For the production of sweet Muscat wine it is much inferior to the small Muscatel or Frontignan, and for blending with other varieties it would be well replaced by that grape, by the Malmsey, or by some of the true Malvoisies, whose flavor is more delicate and more suitable to wine-making.

ANALYSES OF MUSTS AND WINES.

MUSCAT OF ALEXANDRIA.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months.	Body	Ash	Sugar
1890—No. 1288.* Cupertino	Oct. 1	20.40	------	.47	.14	------	------	------	------	------	------
No. 1345.* Mission San José	Oct. 11	25.63	------	.51	.21	15.42†	18.98	.41	2.43	------	4.27
No. 1407.* Cupertino	Oct. 21	24.25	------	.58	------	------	------	------	------	------	------
1891—No. 1456.* Fresno	Aug. 28	25.85	25.30	.41	------	14.50†	17.90	.13	2.45	------	------
No. 1535.* Paso Robles	Oct. 3	24.90	------	.40	------	------	------	------	------	------	------
1892—No. 1696. Tulare	Sept. 27	26.00	------	.46	------	------	------	------	------	------	------
No. 1718. Tulare	Oct. 3	25.90	------	.24	------	------	------	------	------	------	------
No. 1719.* Tulare	Oct. 3	24.80	------	.33	------	------	------	------	------	------	------
No. 1731. Paso Robles	Oct. 11	25.65	------	.36	------	------	------	------	------	------	------
No. 1758.* Paso Robles	Oct. 11	24.25	------	.33	------	------	------	------	------	------	------
1893—No. 1972. Tulare	Oct. 14	24.80	24.43	.48	------	------	------	------	------	------	------
No. 1974.* Tulare	Oct. 14	21.40	20.60	.39	.23	------	------	------	------	------	------
1894—No. 2239.* Mission San José	Oct. 5	21.10	------	.50	------	------	------	------	------	------	------

* Huasco. † Fortified.

Record of Treatment.

No. 1288. *Huasco*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 3, 1890, in good condition, but not quite ripe. The bunches and berries were very large, and apparently the same as the spherical form of the Muscat of Alexandria. The must showed 20.4% of solid contents by spindle and 0.47% of acid.

No. 1345. *Huasco*, from Mission San José. Received October 14, 1890, in fair condition. The bunches were long and loose, but with a little coulure; the berries very large and fine. The must showed 25.63% of solid contents by spindle and 0.51% of acid. The temperature of the grapes at crushing was 69°, and the maximum was 76°, reached on the third day. On the fifth day, while the wine was still a little sweet, it was fortified.

At three months the wine was bright, of medium acid and sweetness, and strong Muscat aroma. At this date it was racked and put in the heating-chamber, at a temperature of 110°, for three months. At eight months it was bright, clean-tasting, and well developed. At this time it was racked for the third time. At sixteen months it was in good order, of strong and pleasing aroma, maturing well, and generally improved, but rather too sweet. It gradually improved, and at four years was a bright, clean-tasting, agreeable Muscat. At this date it was put in glass.

No. 1407. *Huasco*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 24, 1890, in good condition, and mature. The bunches were fairly well filled and the berries large. The must showed 24.25% of solid contents by spindle and 0.58% of acid.

No. 1456. *Huasco*, from Fresno. Received August 31, 1891, in good condition, and mature. The must showed 25.85% of solid contents by spindle and 0.41% of acid. The temperature of the grapes at crushing was 76°. The day after crushing the temperature had fallen to that of the room (73°), and reached its maximum of 77° on the third day. The must fermented slowly, and on the seventh day it was fortified while still sweet.

At four months the wine was bright, clean-tasting, and with delicate Muscat aroma and moderate sweetness. Two months later it was racked for the second time, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years and ten months it was in good order, smooth and agreeable, but in too small a quantity to show its best qualities. Four months later it had improved, and was put in glass.

No. 1535. *Huasco*, from Paso Robles station. A sample for must analysis was received October 5, 1891, in good condition. The bunches were loose and of medium size; the berries were not very large and rather too ripe. The must showed 24.9% of solid contents by spindle and 0.40% of acid.

No. 1696. *Muscat of Alexandria*, from Tulare station. A sample for must analysis was received September 29, 1892, in good condition. The must showed 26.0% of solid contents by spindle and 0.46% of acid.

No. 1718. *Muscat of Alexandria*, from Tulare station. A sample for must analysis was received October 5, 1892, in good condition. The must showed 25.9% of solid contents by spindle and 0.24% of acid.

No. 1719. *Huasco*, from Tulare station. A sample for must analysis was received October 5, 1892, in good condition. The must showed 24.8% of solid contents by spindle and 0.33% of acid.

No. 1731. *Muscat of Alexandria*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 25.65% of solid contents by spindle and 0.36% of acid.

No. 1758. *Huasco*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 24.25% of solid contents by spindle and 0.33% of acid.

No. 1972. *Muscat of Alexandria*, from Tulare station. A sample for must analysis was received October 16, 1893, in good condition. The bunches were of medium size, loose, and irregular; the berries large. The must showed 24.8% of solid contents by spindle and 0.48% of acid.

No. 1974. *Huasco*, from Tulare station. A sample for must analysis was received October 16, 1893, in good condition. The grapes were larger than those of No. 1972, and the bunches showed less coulure. The must showed 21.4% of solid contents by spindle and 0.39% of acid.

THOMPSON'S SEEDLESS.

Synonyms: Sultanina; Sultanieh; Sultani.

Description.—Vine very vigorous, and with large trunk and very long canes; leaves glabrous on both sides, dark yellowish-green above and lighter below, generally three-lobed, with shallow sinuses, teeth short and obtuse; bunch large, conico-cylindrical, well filled, on herbaceous peduncles; berries under medium, ellipsoidal, crisp, of neutral flavor, with moderately thick skin of a fine golden-yellow color.

This variety, which was distributed by Elwanger & Barry, New York, in 1872, as a Turkish variety under the name of Lady Decoverly, received the name it is most commonly known under from Mr. Thompson, of Yuba City, who first distributed it in California.

Judging from the complete description of the Sultanina given by J. M. Guillon (Revue de Viticulture, tome 3, p. 216, 1895) there can be little doubt that our California Thompson's Seedless is identical with it. It is from this grape that the Sultana grapes of Asia Minor are made. It is also grown to some extent in Greece for the same purpose. It bears plentifully, even with short-pruning, though in its native land it is pruned long.

The Sultanina is supposed by some authorities to be a simple cultural variation of the Sultana, but this is extremely improbable, for its distinctly elongated berries denote, in the absence of any intermediate forms, a different origin from the perfectly round berries of the Sultana.

Analyses of Musts.

THOMPSON'S SEEDLESS.	Date of Picking	Solid Contents by Spindle	Acid as Tartaric	Ash
1890—No. 1376. Cupertino	Oct. 15	26.92	.45	------
1892—No. 1636. Tulare	Sept. 4	24.45	.33	------
1893—No. 1894. Tulare	Sept. 23	25.05	.37	.31

Record of Treatment.

No. 1376. *Thompson's Seedless*, from Cupertino. A sample for must analysis was received October 17, 1890, in good condition. The bunches were irregular, winged, and loose, on slender, green peduncles; the berries oblong, of light golden color, on long pedicels; the skin was thick but tender, the flesh crisp, sweet, and agreeable. The must showed 26.92% of solid contents by spindle and 0.45% of acid.

No. 1636. *Thompson's Seedless*, from Tulare station. A sample for must analysis was received September 6, 1892, in good condition. The must showed 24.45% of solid contents by spindle and 0.33% of acid.

No. 1894. *Thompson's Seedless*, from Tulare station. A sample for must analysis was received September 25, 1893, in good condition. The bunches were of medium size, well filled, but not compressed; the berries under medium size, very irregular in shape, from nearly spherical to long ellipsoidal; peduncles and pedicels slender; flesh crisp and very sweet; color golden-yellow, with light bloom. The must showed 25.05% of solid contents by spindle and 0.37% of acid.

SULTANA.

(See Vit. Rept. 1885–86, p. 102.)

Synonym: Seedless Sultana.

Description.—Vine vigorous, upright; leaves large, five-lobed, with rather shallow sinuses, light colored, and coarsely toothed; bunches large, long-cylindrical, with heavy shoulders or wings, well filled when not coulured, but not compacted; berries small, round, firm and crisp, golden-yellow, and without seeds.

The Sultana is widely cultivated in California as a raisin and table grape, though for the latter purpose it is being partially superseded by Thompson's Seedless. It does not correspond to any available description of European or Asiatic grapes. The Sultanina, from which the bulk of the seedless raisins of Smyrna is made, resembles much more closely the Thompson's Seedless than our California Seedless Sultana. As a raisin-grape the Sultana is too well known to need any description. It is for raisins, rather than for wine-making, that it will be found useful. Its wine is neutral and fairly agreeable, but never attains high quality and is not a very good keeper. Blended with other grapes it may be used in the production of sweet wines, but, in the coast counties especially, its acid is rather too high for this purpose. It is to this acidity that the superior piquancy which is claimed for its raisins over those of the Thompson's Seedless is doubtless due. The identity of this grape has not yet been established. It is probably the round-berry Kechmish to which Odart refers, and which he says enters into the composition of the wines of Schiraz.

ANALYSES OF MUSTS AND WINES.

SULTANA.	Date of Picking	MUST.				WINE.				
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six Months	Volatile Acid at Six Months	Body
						By Weight	By Volume			
1887—No. 774. Cupertino	Oct. 24	26.10	26.31	.41	.34	10.81	13.27	.47	.06	2.30
1888—No. 892. Cupertino	Oct. 8	22.97	23.13	.49	.27	10.63	13.09	.48	----	2.70
No. 893. Cupertino	Oct. 8	26.51	27.65	.39	.29					
1890—No. 1356. Mission San José	Oct. 13	26.60	----	.54	----	----	----	----	----	----
1891—No. 1483. Fresno	Sept. 9	22.11	21.22	.60	----	*15.50	19.08	.44	----	3.30
1892—No. 1711. Mission San José	Oct. 4	25.00	25.19	.62	.25	9.56	11.91	.61	----	2.70
No. 1715. Tulare	Oct. 3	21.20	----	.30	----	----	----	----	----	----
1893—No. 2066. Mission San José	Nov. 1	27.15	----	.60	----	----	----	----	----	----
1894—No. 2245. Mission San José	Oct. 3	26.00	----	.56	----	----	----	----	----	----

*Fortified.

RECORD OF TREATMENT.

No. 774. *Seedless Sultana*, from J. T. Doyle, Cupertino. Received October 25, 1887, in good condition. The bunches and berries were very uneven in size, and showed some coulure. Part of the grapes were from long-pruned and part from short-pruned vines. Those from long-pruned vines were the finest and showed the least coulure. The must showed 26.1% of solid contents by spindle and 0.41% of acid. The temperature of the grapes at crushing was 74°, and the maximum reached was 84°, on the second day. The fermentation was over on the eleventh day, when the wine was racked off.

At one month the wine was racked and taken to the cellar. A month later it was clear, sound, with low, pleasant acid, but little character. At four months it was racked for the third time, and at seven months it was bright, pleasant, and sound. At this date a microscopical examination of the lees showed no unsound ferments, and the wine was racked into glass. A month later the wine was in good condition and had developed a little bouquet.

Nos. 892 and 893. *Seedless Sultana*, from J. T. Doyle, Cupertino. Received October 9, 1888, in good condition. The numbers refer to samples from long-pruned and from short-pruned vines, respectively. Both samples showed a good deal of coulure, but the long-pruned was the most evenly ripened, though somewhat sunburned. The must showed 22.97% of solid contents by spindle and 0.49% of acid for the short-pruned, and

26.51% of solid contents by spindle and 0.39% of acid for the long-pruned. The must from both samples was fermented in one cask.

At seventeen days the wine was drawn off, and at one month it was racked and taken to the cellar. At three months it was clear, of good flavor, pleasant acid, and adequate alcohol. At five months it was racked again, and the lees examined and found to be sound. Tastings at ten and at fourteen months showed improvement and the development of some bouquet. At sixteen months it was bright and of good bouquet, but the after-taste was not quite clean. At this time the wine was racked and part put in bottle. At twenty-one months the lees were sound and the wine was bright, improved generally, clean-tasting, and with good flavor. A month later it was bottled. At twenty-eight months the wine bottled at sixteen months was clear, but had made some deposit in the bottle; that bottled at twenty-two months was bright, without deposit, and of good quality. At four years both wines were very good, but the second bottling was fresher-tasting and had a more pronounced bouquet.

No. 1356. *Sultana*, from Mission San José. A sample for must analysis was received October 14, 1890, in good condition. The bunches were large, winged, with medium-sized berries. The must showed 26.6% of solid contents by spindle and 0.54% of acid.

No. 1483. *Sultana*, from Egger's Vineyard, Fresno. Received September 11, 1891, in good condition. The must showed 22.11% of solid contents by spindle and 0.60% of acid. The temperature of the grapes at crushing was 70°, and the maximum, reached the sixth day, was 73°. The fermentation was very slow, and on the eleventh day the wine was fortified.

At four months the wine was bright, mild, and clean-tasting, of medium sweetness, and almost colorless. A month later it was racked for the second time, and at six months put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years and ten months the wine was bright and in good order, but lacking in flavor, and vapid, without any real Sherry flavor. Four months later it had improved a little, but lacked character. It was put in glass, on account of the smallness of the quantity.

No. 1711. *Sultana*, from Mission San José. Received October 5, 1892, in fair condition. The must showed 25% of solid contents by spindle and 0.62% of acid. The temperature of the grapes at crushing was 69°, and the maximum, reached the third day, was 80°. On the eighth day the wine was dry, and was racked off.

At one month the wine was cloudy, but was quite dry. It was racked for the second time, and at three months it was bright, with little aroma, but pleasant flavor, medium acid, full body, and clean taste. At five months, when it was racked again, it was in good condition and had improved. At eight months it was in good order, but had not developed any bouquet. At ten months it showed a little bouquet. At fourteen months it was very good, and had kept remarkably well, considering the smallness of the quantity. A month later it was bottled.

No. 1715. *Sultana*, from Tulare. A sample for must analysis was received October 5, 1892, in good condition. The must showed 21.2% of solid contents by spindle and 0.30% of acid.

No. 2066. *Sultana*, from Mission San José. A sample for must analysis was received November 1, 1893, in good condition. The bunches were large, irregularly branching, and well filled; the berries from small to medium, and very sweet. The must showed 27.15% of solid contents by spindle and 0.60% of acid.

BLACK TABLE-GRAPES.

BLACK HAMBURG AND BLACK PRINCE.

(See Vit. Rept. 1885–86, p. 76.)

Synonyms: Trollinger; Frankenthaler.

Description.—Vine very vigorous, with thick, light-colored canes; leaves large, wider than long, not deeply cut, glabrous above and nearly so below, except for a considerable hairiness on the nerves; bunches large, short, winged, rather loose, on long peduncles; berries large to very large, generally round, and on long pedicels; flesh firm, crisp, juicy, and with little flavor, but agreeable to eat.

The Black Hamburg takes the place among red grapes occupied by Chasselas among the white. Its regularity of bearing, the ease with which it is cultivated, and the wide range of conditions under which it thrives as a table-grape, have caused it to be planted in small quantities over almost the whole of the vine-growing world. This wide distribution has led to the production of innumerable variations of the grape, and to a large and confusing synonymy. The Black Prince, which is now extensively cultivated in California as a table-grape for the home market, seems to be only one of the numerous variations of the Black Hamburg, valuable for its large bunches of fine, crisp, but rather flavorless berries. The few wines made from it show it to be little better for this purpose in California than the Black Hamburg. It attains, apparently, a higher percentage of sugar, but makes an equally characterless, vapid wine, of poor keeping qualities.

ANALYSES OF MUSTS AND WINES.

BLACK PRINCE.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
						By Weight	By Volume		At Pressing	At Six Months	
1887—No. 781. Cupertino	------	24.70	24.64	.53	.44	10.35	12.82	.240	.45	.45	3.10
1890—No. 1265.* Cupertino	Sept. 28	15.87	------	.54	------	------	------	------	------	------	------
1892—No. 1699. Tulare	Sept. 28	24.10	------	.33	------	------	------	------	------	------	------
1893—No. 1956. Paso Robles	Oct. 13	25.20	24.12	.42	.38	9.49	11.82	.102	.42	.46	2.80
No. 2003. Tulare	Oct. 21	23.70	22.40	.32	.50	8.62	10.75	.071	.33	.43	2.50
1894—No. 2347. Tulare	Oct. 27	23.70	------	.18	------	------	------	------	------	------	------

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* Black Hamburg.

RECORD OF TREATMENT.

No. 781. *Black Prince*, from J. T. Doyle, Cupertino. Received October 26, 1887, in good condition. The stems were green, but the grapes were fully ripe and a few were overripe. The berries were slightly oval, very large, soft, juicy, and thin-skinned. The must showed 24.7% of solid contents by spindle and 0.53% of acid. The grapes were crushed after arrival at a temperature of 70°. The maximum temperature, reached the third day, was 83°. The fermentation was very violent, and was finished on the fifth day.

At two months the wine was very pleasant, clean-tasting, and light-bodied. At four months it was racked for the second time; it was bright, clean-tasting, but thin and without special flavor. For three or four months it remained bright and of fair quality, but later it deteriorated and did not keep well.

No. 1699. *Black Prince*, from Tulare station. A sample for must analysis was received September 29, 1892, in good condition. The must showed 24.1% of solid contents by spindle and 0.33% of acid.

No. 1956. *Black Prince*, from Paso Robles station. Received October 15, 1893, in fair condition. The bunches were large and irregular, loose; the berries on some bunches were large, well formed, and well colored, on others abortive and dried up. The must showed 25.2% of solid contents by spindle and 0.42% of acid. The grapes at crushing showed 64°, and the maximum temperature, reached the third day, was 81°. On the fourth day the wine was dry, and on the fifth day it was drawn off.

At one month the wine was racked for the second time and taken to the cellar; it was almost clear, but contained a little sugar and was almost without color. At three months it was clear, but thin, flat, and of very poor quality. A month later it was racked again, but did not improve.

No. 2003. *Black Prince*, from Tulare station. Received October 23, 1893, in good condition. The bunches were large, conical, shouldered, well filled, but not compact; the berries large, oval, light colored, and very sweet. Some second-crop bunches mixed with the others were smaller, and had smaller and more deeply colored berries, which were less ripe than the first crop. The must showed 23.7% of solid contents by spindle and 0.32% of acid. The temperature of the grapes at crushing was 67°. The must fermented slowly, and was still a little sweet when drawn off on the fourth day. The wine was of poor quality, and soon deteriorated. At three months it was clear, but flat and worthless. It did not improve, and at six months was thrown away.

GROS COLMAN.

Synonyms: Dodrelabi; Ochsenauge; Eichkugeltraube.

Description.—Vine strong-growing, with dark brownish wood; leaves very large, round, thick, very slightly lobed, shortly and bluntly toothed, glabrous above, close-woolly below; bunches large, short, well filled, but not compact; berries very large, round, dark blue, with thick but tender skin.

The Dodrelabi is remarkable, as having the largest berries of any round-berry variety known. It is cultivated largely in eastern and central Europe, and is also a very great favorite in the hothouses of England and Belgium. It is probably the handsomest black table-grape grown; its large, round berries, which are not pressed out of shape by too great compactness of the bunches, are very attractive in appearance and very agreeable too eat. The grapes have good keeping qualities, except that they are very liable to crack. They are, on this account, difficult to ship to any great distance.

ANALYSES OF MUSTS.

GROS COLMAN.	Date of Picking	Solid Contents by Spindle	Acid as Tartaric	Ash
1890—No. 1269. Cupertino	Oct. 1	14.70	.57	------
No. 1425. Mission San José	Oct. 29	21.95	.42	------
1893—No. 1932. Paso Robles	Oct. 11	15.20	.40	.33
No. 1973. Tulare	Oct. 14	21.50	.41	.33

RECORD OF TREATMENT.

No. 1269. *Gros Colman*, from Cupertino. A sample for must analysis was received October 2, 1890, in fair condition, some of the berries being cracked and not quite ripe. The must showed 14.7% of solid contents by spindle and 0.57% of acid.

No. 1425. *Gros Colman*, from Mission San José. A sample for must analysis was received October 31, 1890, in poor condition. The grapes were mature and very fine-looking, but crushed and moldy. The must showed 21.95% of solid contents by spindle and 0.42% of acid.

No. 1932. *Gros Colman*, from Paso Robles. A sample for must analysis was received October 13, 1893, in fair condition. The grapes were very irregular in size and coloring; some bunches were well filled with large, well-colored berries, others were loose, with small, greenish, flavorless berries. The must showed 15.2% of solid contents by spindle and 0.40% of acid.

No. 1973. *Gros Colman*, from Tulare. A sample for must analysis was received October 16, 1893, in good condition. The bunches were of medium size, cylindrical, close; the berries very large, crisp, juicy, and tender-skinned, with little flavor and not very sweet, though some berries were commencing to dry up. The must showed 21.5% of solid contents by spindle and 0.41% of acid.

BLACK MOROCCO.

Description.—Vine a strong grower, with thin, spreading canes; leaves under medium size, very deeply five-lobed, even when very young, the younger leaves truncate at base, giving them a semi-circular outline, with long, sharp teeth alternating with very small ones, glabrous on both sides; bunches very large, short, shouldered, and compact; berries very large, round, often angular from compression, fleshy, of neutral flavor, dull purple color or colorless in the center of the bunch. This grape is remarkable for the number of second-crop bunches which it produces on the laterals.

The Black Morocco is late in ripening and of very fine appearance, a fairly good shipping-grape, but difficult to pack on account of the size and rigidity of the bunches. The grapes are of an agreeable crispness, but lacking in flavor.

RECORD OF TREATMENT.

No. 1351. *Black Morocco*, from Cupertino. A sample for must analysis was received October 13, 1890, in good condition, and mature. The must showed 16.7% of solid contents by spindle and 0.65% of acid.

No. 2024. *Black Morocco*, from Tulare station. A sample for must analysis was received October 26, 1893, in good condition. The bunches were of medium size, short cylindrical, and compact; the berries very large and fairly well colored. The must showed 20.2% of solid contents by spindle and 0.45% of acid.

CALIFORNIA BLACK MALVOISIE.

(See Vit. Rept. 1887-89, p. 212.)

This variety, which has been afflicted with more inappropriate and misleading synonyms than fall to the lot of most grapes, even in California, resembles the Cinsaut in its berries and in the form of its leaves; but the bunches are much more loose and lack the peculiar aroma of the Cinsaut, and the leaves are much larger and the vine of stronger and longer growth. Its wine matures quickly, and is pleasant to the taste at six to eight months, but does not improve with age, and is a poor keeper. It is certainly utterly different from any variety of the Malvoisie type, but the name given above has become so closely identified with it that it is perhaps best to retain it. This variety has been generally abandoned, except as a table-grape for local markets.

ANALYSES OF MUSTS.

CALIFORNIA BLACK MALVOISIE.	Date of Picking	MUST.	
		Solid Contents by Spindle	Acid as Tartaric
1891—No. 1478. Paso Robles	Sept. 1	22.80	.55
1893—No. 1855. Amador station	Sept. 12	20.20	.60
1894—No. 2194. Amador station	Sept. 25	23.40	.59
No. 2224. Amador station	Oct. 3	27.60	.43

RECORD OF TREATMENT.

No. 1478. *California Malvoisie*, from Paso Robles station. A sample for must analysis was received September 3, 1891, in good condition, and riper than the Cinsaut from the same place. The must showed 22.8% of solid contents by spindle and 0.55% of acid.

No. 1855. *California Malvoisie*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition. The bunches were of good size, well filled, but not compact; the berries large and not quite mature; there was no sign of coulure. The must showed 20.2% of solid contents by spindle and 0.60% of acid.

CORNICHON.

Synonyms: Cornichon Violet; Eicheltraube.

Description.—Vine a heavy grower, with thick, light brown, short-jointed wood; leaves large, longer than wide, deeply five-lobed, dark green above, and lighter and very hairy below, coarsely toothed, and with short, thick petiole; bunches very large, loose, on long peduncles; berries large, long, more or less curved, darkly colored and spotted, thick-skinned, and on long pedicels.

This variety has been grown as a table-grape with great success in California, and is desirable on account of its attractive appearance, curious shape, excellent shipping qualities, and late ripening. On account of the length of its stalks and the looseness of its bunches, it is very easy to pack, even when the bunches are very large. The grapes grown at

Tulare under this name seem to differ considerably from the typical Cornichon as it is found in the more northern counties. It has more symmetrical berries and lighter color.

Record of Treatment.

No. 1350. *Purple Cornichon*, from Cupertino. Received October 13, 1890, in good condition. A sample for must analysis was all that was received. The grapes were mature, and showed 17.2% of solid contents by spindle and 0.68% of acid.

No. 2007. *Purple Cornichon*, from Tulare station. A sample for must analysis was received October 23, 1893, in good condition. The bunches were small, irregular, loose; the berries large, long-elliptical, symmetrical, varying in color from brownish-pink to purple, fleshy, and thick-skinned. The must showed 19.3% of solid contents by spindle and 0.50% of acid.

EMPEROR.

Description.—Vine a strong, vigorous grower; leaves very large, with five shallow lobes, short, obtuse teeth, glabrous above, woolly beneath, light green in color; bunches very large, long, conical, loose, with large, dull purple, oval, firm berries.

This is an excellent shipping-grape of fine appearance, but of little flavor, and thick-skinned. When grown in a suitable location, and when properly trained, it is an immense bearer, and very satisfactory as a late shipping-grape. The vine must be allowed to extend itself; the vine and its arms should reach for seven or eight feet at least and should be short-pruned. When it is cut back to a mere stump the grapes do not set well.

Record of Treatment.

No. 1349. *Emperor*, from Cupertino. A sample for must analysis was received October 13, 1890, in good condition, and mature. The must showed 19.3% of solid contents by spindle and 0.66% of acid.

No. 2236. *Emperor*, from Mission San José. A sample for must analysis was received October 4, 1894, in good condition. The bunches were large, loose, with little coulure; berries large, hard, and without flavor. The must showed 15.4% of solid contents by spindle and 0.72% of acid.

RED TABLE-GRAPES.

BARBAROSSA.

Synonyms: Barbarossa del Piedmonte; Uva Regina.

Description.—Vine prolific and of medium vigor; leaves small, deeply five-lobed, with closed sinuses, glabrous on both sides except for some short, stiff hairs on the under side; bunches large, very much winged, well filled; berries over medium size, round, crisp, juicy, and of agreeable but neutral flavor, skin tender and of a bright rose color.

This variety is cultivated to a large extent in Piedmont as a late table-grape, and to a less extent as a wine-grape. There are several distinct varieties, which go under the name of Barbarossa in Italy, but the one described above, which is the one at the Experiment Stations, is the most esteemed. At Mission San José and at Cupertino it has shown itself a fair bearer and a very agreeable and showy table-grape. It is, however, too delicate for general shipping purposes in California. At Tulare it has borne well, but failed to color. As a wine-grape the results have not been promising. Alone, it makes a thin, neutral wine. However, as it attains uniformly a good percentage of sugar with adequate acid, it might be used as a blend with a variety of more character. It can at present be recommended only as a showy table-grape for home use and for keeping during the winter months. The vine bears well with short-pruning, and requires a fairly rich soil in a warm, dry location. On irrigated or over-rich soils it fails to color.

Analyses of Musts and Wines.

BARBAROSSA.	Date of Picking	MUST.				WINE.				
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six Months	Volatile Acid, at Six Months	Body
						By Weight	By Volume			
1887—No. 746. Cupertino	Oct. 16	24.60	23.61	.47	.42	10.16	12.64	.52	.07	2.60
1890—No. 1266. Cupertino	Sept. 29	22.90	------	.58	.27	------	------	------	----	------
No. 1429. Mission San José	Oct. 28	28.50	------	.44	----	------	------	------	----	------
1892—No. 1740. Paso Robles	Oct. 10	24.80	------	.37	----	------	------	------	----	------
No. 1775. Mission San José	Oct. 13	22.85	23.13	.59	----	9.34	11.64	.65	----	2.44
1893—No. 1980. Tulare	Oct. 17	21.50	20.69	.47	.30	8.20	10.25	.45	----	2.80
No. 1995. Mission San José	Oct. 19	24.80	------	.52	----	------	------	------	----	------
No. 2088. Cupertino	Nov. 4	24.80	------	.77	----	------	------	------	----	------
1894—No. 2230. Mission San José	Oct. 3	22.80	------	.48	----	------	------	------	----	------

Record of Treatment.

No. 746. *Barbarossa*, from J. T. Doyle, Cupertino. Received October 18, 1887, in excellent condition. The bunches were very large and short; the berries very large, sweet, and with little acid or flavor. The must showed 24.6% of solid contents by spindle and 0.47% of acid. The temperature of the grapes at crushing was 80°, and the maximum, reached the following day, was 86°. The wine was drawn off the thick lees on the tenth day.

At two months the wine was bright, of fair aroma, adequate and pleasant acid, good body—a sound but neutral wine. A month later it was racked again and pasteurized for safety. At eight months it was bright, but quite neutral and somewhat flat.

No. 1266. *Barbarossa*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 2, 1890, in good condition, and mature. The bunches were large, pyramidal, and close; the berries varying from large to very small; skin thick but tender; color light garnet, except those in the middle of the bunch, which were green; pulp crisp, juicy, sweet, with neutral flavor; peduncles thick and strong. The must showed 22.9% of solid contents by spindle and 0.58% of acid.

No. 1429. *Barbarossa*, from Mission San José. A sample for must analysis was received October 30, 1890, in fair condition, and mature. The must showed 28.5% of solid contents by spindle and 0.44% of acid.

No. 1740. *Barbarossa*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 24.8% of solid contents by spindle and 0.37% of acid.

No. 1775. *Barbarossa*, from Mission San José. Received October 15, 1892, in good condition. The must showed 22.85% of solid contents by spindle and 0.59% of acid. The temperature of the must at crushing was 62°, and the maximum, reached the fourth day, was 80°. On the ninth day the wine was racked off the thick lees.

At one month the wine was quite clear. At this date it was racked for the second time and taken to the cellar. At three months it was bright, without aroma, but with some flavor, of medium acid, and good body; a clean-tasting, neutral wine. Two months later it was racked again; it was in good order and was very pleasing, but of perfectly neutral character. Tastings at eight, ten, and fourteen months showed that the wine remained in good order; it was of pleasing character, but neutral and quite lacking in bouquet. At seventeen months it was bottled.

No. 1980. *Barbarossa*, from Tulare station. Received October 18, 1893, in good condition. The bunches were large to medium, winged, and close; the berries large, round, soft, and juicy, most of them green in color, but some pinkish and the second-crop bunches rose-colored. The must showed 21.5% of solid contents by spindle and 0.47% of acid. The temperature of the grapes at crushing was 63°, and the maximum, reached the third day, was 78°. The wine was dry on the fifth day, when it was racked off.

In three weeks the wine was clear, but rather flat and insipid. A month later it had improved somewhat, but showed little character. At this time it was racked and taken to the cellar. At three months it was clear, a fair, neutral wine, with little flavor or aroma. A month later it was racked again, and at six months it was in good order, sound but somewhat characterless. At ten months it had suffered a little from the smallness of the keg; it was mature, and was bottled.

No. 1995. *Barbarossa*, from Mission San José. A sample for must analysis was received October 19, 1893, in good condition. The bunches were large, conico-cylindrical, winged or shouldered, rather close; the berries a little over medium size, slightly ob-compressed when free, fleshy and fairly resistant, of a deep rose color, sweet and pleasant to eat. The must showed 24.8% of solid contents by spindle and 0.52% of acid.

No. 2088. *Barbarossa*, from J. T. Doyle, Cupertino. A sample for must analysis was received November 6, 1893, in good condition. The bunches were of medium size, irregular, branching, a little coulured; the berries of unequal size, round, crisp, and with full acid. The must showed 24.8% of solid contents by spindle and 0.77% of acid.

FLAME TOKAY.

Synonyms: Flaming Tokay; Uva de Ragol.

Description.—Vine a strong grower; leaves of medium size, light yellowish-green in color, slightly lobed, long-toothed, glabrous on both sides; bunches large, close, conico-cylindrical, on thick peduncles; berries large, longer than wide, flattened at the ends, fleshy, crisp, flesh-colored where exposed to the light, green when too much shaded.

This variety, which has been grown so extensively in California as a shipping-grape, is the "Uva de Ragol" or "Culo de Horza," which is grown largely in Sevilla, and where it is very highly valued as a good-keeping grape, a reputation which it sustains equally in California. It is most successful on a clayey soil; on sandy and alkali soils it bears well, but fails to color its berries well. The vine has been supposed to be able to resist the phylloxera. It resists, however, only in a manner similar to several other European varieties; that is to say, when it is in a particularly favorable soil it will continue to live for many years after its roots are thoroughly invaded by the insect, and after other varieties in the same ground are dead. It is not properly a resistant, for it is so injured and weakened by the attacks of the parasite that it is worthless either for direct bearing or grafting.

Record of Treatment.

No. 1928. *Flame Tokay*, from Natoma. A sample for must analysis was received October 12, 1893, in good condition. The must showed 19.5% of solid contents by spindle and 0.36% of acid.

WHITE TABLE-GRAPES.

LUGLIENGA.

Synonyms: Lignanga; Lignan blanc; Gelbe Seidentraube.

The wide range of this grape is indicated by the host of synonyms under which it labors, and of which the above are but a few of the commoner.

Description.—Vine strong-growing, and sensitive to frost; leaves of medium size, deeply five-lobed, dark green, glabrous on both sides, sharply toothed, the terminal tooth of each lobe very long and acuminate; bunches of medium size, well filled; berries of medium size, oval, at first green, becoming yellow with overripeness, with thin skin, crisp, firm flesh, and agreeable flavor.

The Luglienga, the name of which means July grape, is one of the earliest grapes known. This, in connection with its good quality as an eating-grape, and the length of time which it will keep, has made it a favorite grape for home use nearly all over Italy and in many parts of France, Austria, and Germany. It is said that one vine of this variety will often suffice to supply a whole family with grapes from the beginning to the end of the grape season. It is on account of this fact that it is called in Piedmont "Bona in Ca," meaning "good to grow on the house."

The name of "Seidentraube" (silk grape) comes from the peculiar soft feeling which the grape has when being eaten, and which is one of its chief merits. The vine is unsuited to head-pruning, and seldom produces more than half a crop, on account of its liability to coulure unless allowed to extend itself. This grape would be excellent for home markets, and much superior to the early Sweetwaters, which usually appear in the market first. It is rather too thin-skinned for long shipments, but if handled carefully will keep a long time.

Record of Treatment.

No. 1210.* *Luglienga*, from Fresno. A sample for must analysis was received August 25, 1890, in fair condition. The grapes were quite ripe, and showed 20.85% of solid contents by spindle and 0.32% of acid.

No. 1214. *Luglienga*, from Fresno. A sample for must analysis was received August 25, 1890, in fair condition. The grapes were overripe, and showed 20.85% of solid contents by spindle and 0.33% of acid.

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*Imported under name of Gelbe Seidentraube.

No. 1305.* *Luglienga*, from Cupertino. A sample for must analysis was received October 8, 1890, in good condition, but overripe and commencing to shrivel. The must showed 24.25% of solid contents by spindle and 0.34% of acid.

No. 1441. *Luglienga*, from Tulare station. A sample for must analysis was received August 29, 1891, in good condition. The must showed 23.7% of solid contents by spindle and 0.36% of acid.

No. 1812. *Luglienga*, from Amador station. A sample for must analysis was received September 1, 1893, in good condition. The must showed 21.1% of solid contents by spindle and 0.47% of acid.

No. 2087. *Luglienga*, from Cupertino. A sample for must analysis was received November 6, 1893, in good condition. The bunches were of medium size, long-conical, winged, well filled; berries under medium size, oval, very sweet, and overripe, but still firm and of very agreeable flavor. The must showed 28.0% of solid contents by spindle and 0.35% of acid.

PIZZUTELLO DI ROMA.

Synonyms: Weisse Eicheltraube; Cornichon blanc; Santa Paula.

Description.—Leaves five-lobed not deeply cut, together with the young shoots glabrous on both sides; bunches large, long, loose; berries long and thin, generally curved, crisp, thin-skinned.

The synonomy given above is perhaps a little doubtful, and may include two varieties similar in fruit but differing in leaf characters. The one described is the favorite table-grape grown in the outskirts of Rome. It is of very attractive appearance and agreeable crispness, but almost totally lacking in flavor. Its remarkably thin and tender skin increases its desirability as an eating-grape, but militates very much against its shipping qualities. It is much inferior in this respect to the Black Cornichon, which it resembles in shape and flavor.

Record of Treatment.

No. 2006. *Pizzutello di Roma*, from Tulare. A sample for must analysis was received October 23, 1893, in good condition. The bunches were of medium size, short-cylindrical, loose, on slender peduncles; the berries large, long, generally curved, hard, flavorless, on thick pedicels. The must showed 22.2% of solid contents by spindle and 0.38% of acid.

ALMERIA.

Description.—Vine vigorous; leaves of medium size, round, and slightly or not at all lobed, quite glabrous on both sides, teeth obtuse and alternately large and small; bunches large, loose or compact, irregularly conical; berries from small to large, cylindrical, flattened on the ends, very hard and tasteless.

The grape cultivated at the Experiment Stations under this name is one of the several varieties which are shipped in such large quantities from Malaga and Almeria packed in sand or cork-dust. The chief of these varieties are the De Loxa, Ataubi, and Ciuti, all white grapes of similar character, having the common properties of late ripening, hard, crisp flesh, and firm attachment to the pedicel. Which of these varieties we have under the name of Almeria has not yet been determined. The above description is drawn up from the vines growing at the Tulare station.

The grapes ripen late and attain about 20.0% of sugar. They have remarkable keeping qualities and resist mold, fermentation, and drying-up better than any grape which we have tried. Some berries, detached from the bunch and placed loose in a box, remained perfectly good and with very little shriveling for over four months. The difficulty which has been experienced in causing this variety to bear has been, in the cooler localities, due to the lack of sufficient heat, but in the hot interior valleys to an unsuitable method of pruning. An instance was brought to our notice by Mr. A. D. Shepard, which illustrates this fact. A vineyardist in the San Joaquin Valley, becoming disgusted with a patch of these vines which he had been cultivating for years without obtaining any grapes, allowed the vines to grow without any care, not even pruning them. The next season he obtained a large crop.

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*Imported under name of Gelbe Seidentraube.

At Tulare the vines being allowed to extend themselves have given good crops. The vine should therefore be trained on trellis or wires, allowed to spread over a good deal of ground, and should only be planted in the hotter localities.

RECORD OF TREATMENT.

No. 2023. *Almeria*, from Tulare station. Received October 26, 1893, in good condition. The bunches were large, loose to compact, irregularly conical; berries from small to large, cylindrical, flattened on the ends, very hard and tasteless. The must showed 19.7% of solid contents by spindle and 0.54% of acid.

AMERICAN TYPE.

HERBEMONT.

Description.—Vine a vigorous grower, with slender, short-jointed canes; leaves of medium size, with five strongly marked lobes, yellowish-green and glabrous above, very rough and hairy below; bunches of medium size to large, well shouldered, compact; berries small, round, juicy, with little foxiness.

Analyses of Musts and Wines.

HERBEMONT.	Date of Picking	MUST.			WINE.					
		Solid Contents by Spindle	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Acid at Pressing	Acid at Six Months	Tannin	Body
1890—No. 1386. Cupertino	Oct. 19	22.40	.69	------	------	------	------	------	------	------
1892—No. 1749. Paso Robles	Oct. 11	23.70	.56	------	------	------	------	------	------	------
No. 1767. Mission San José	Oct. 16	21.30	1.05	------	8.48	10.58	.96	.73	.222	2.95
1893—No. 2001. Tulare	Oct. 21	20.20	.76	.37	7.43	9.27	.75	.52	.134	3.00
No. 2125. Cupertino	Nov. 3	24.40	.85	------	------	------	.90	------	.163	------

Record of Treatment.

No. 1386. *Herbemont*, from Cupertino. A sample for must analysis was received October 21, 1890, in good condition, and ripe. The must showed 22.4% of solid contents by spindle and 0.69% of acid.

No. 1749. *Herbemont*, from Paso Robles. A sample for must analysis was received October 13, 1892, in good condition. The grapes were very small, and showed 23.7% of solid contents by spindle and 0.56% of acid.

No. 1767. *Herbemont*, from Mission San José. Received October 18, 1892, in good condition. The must showed 21.3% of solid contents by spindle and 1.05% of acid. The temperature of the grapes at crushing was 58°, and the maximum, reached the fourth day, was 87°. On the fifth day the wine was dry, and was drawn off.

The wine was blended with a small quantity of Petit Bouschet, but unfortunately the record of the exact amount was lost. At two months the wine was clear, dry, and of deep color. At three months it was racked for the second time; it was bright, sound, and with full acid, not delicate, but with little foxiness. Two months later it was equally good; it was a good, sound wine, but not of agreeable aroma. At this date it was racked again. At eight months it showed advanced development and had improved. At fourteen months it had retained its good qualities, but was still rather rough. Four months later it was put in bottle.

No. 2001. *Herbemont*, from Tulare. Received October 23, 1893, in good condition. The bunches were small, irregularly conical, close; the berries small, nearly round, with very little foxiness, not well colored. The must showed 20.2% of solid contents by spindle and 0.76% of acid. The temperature of the grapes at crushing was 68°, and the maximum, reached the third day, was 94°. On the fourth day the wine was dry, and was racked off.

At one month the wine was clear, and was racked off and taken to the cellar. At four months it was racked again; it was clear, very light in color, clean-tasting, and of good acid, but not of good aroma. At this date it was racked for the second time. After this the wine deteriorated, and at ten months was flat and poor; the lees showed unsound germs. At sixteen months it was a flat, tasteless wine, without color or other good quality.

No. 2125. *Herbemont*, from Cupertino. A sample for must analysis was received November 5, 1893, in good condition. The bunches were of medium size, conical, winged, close; the berries under medium size, crisp, somewhat pulpy, sweet, with good acid and little foxiness. The must showed 24.4% of solid contents by spindle and 0.85% of acid.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF RAISIN, TABLE, AND OTHER GRAPES.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric.		Body
									At Pressing	At 6 to 8 Months	
	RAISIN GRAPES.										
	Muscat of Alexandria.										
1288	Cupertino	1890	20.40	------	.47	.14	------	------	------	------	------
1407	Cupertino	1890	24.25	------	.58	------	------	------	------	------	------
1345	Mission San José	1890	25.63	------	.51	.21	*18.98	------	------	.41	2.43
2239	Mission San José	1894	21.10	------	.50	------	------	------	------	------	------
1456	Fresno	1891	25.85	25.30	.41	------	17.90	------	------	.13	2.45
1535	Paso Robles	1891	24.90	------	.40	------	------	------	------	------	------
1731	Paso Robles	1892	25.65	------	.36	------	------	------	------	------	------
1758	Paso Robles	1892	24.25	------	.33	------	------	------	------	------	------
1696	Tulare	1892	26.00	------	.46	------	------	------	------	------	------
1718	Tulare	1892	25.90	------	.21	------	------	------	------	------	------
1719	Tulare	1892	24.80	------	.33	------	------	------	------	------	------
1972	Tulare	1893	24.80	24.43	.48	------	------	------	------	------	------
1974	Tulare	1893	21.40	20.60	.39	.23	------	------	------	------	------
	Average, Cupertino	------	**22.33**	------	**.53**	**.14**	------	------	------	------	------
	Average, Mission San Jose	------	**23.37**	------	**.50**	**.21**	------	------	------	------	------
	Average, Paso Robles	------	**24.93**	------	**.36**	------	------	------	------	------	------
	Average, Tulare	------	**24.58**	**22.52**	**.38**	**.23**	------	------	------	------	------
	Sultana.										
774	Cupertino	1887	26.10	26.31	.41	.34	13.27	------	------	.47	2.30
892	Cupertino	1888	22.97	23.13	.49	.27	13.09	------	------	.48	2.70
893	Cupertino	1888	26.51	27.65	.39	.29					
1356	Mission San José	1890	26.60	------	.54	------	------	------	------	------	------
1711	Mission San José	1892	25.00	25.19	.62	.25	11 91	------	------	.61	2.70
2066	Mission San José	1893	27.15	------	.60	------	------	------	------	------	------
2245	Mission San José	1894	26.00	------	.56	------	------	------	------	------	------
1483	Fresno	1891	22.11	21.22	.60	------	*19.08	------	------	.44	*3.30

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* Fortified.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF RAISIN, TABLE, AND OTHER GRAPES—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric.		Body
									At Pressing.	At 6 to 8 Months	
	Sultana—Continued.										
1715	Tulare	1892	21.20	------	.30	------	------	------	------	------	------
	Average, Cupertino	------	**25.19**	**25.69**	**.43**	**.30**	**13.18**	------	------	**.47**	**2.50**
	Average, Mission San Jose	------	**26.18**	**25.19**	**.45**	**.25**	**11.91**	------	------	**.61**	**2.70**
	Thompson's Seedless.										
1376	Cupertino	1890	26.92	------	.45	------	------	------	------	------	------
1636	Tulare	1892	24.45	------	.33	------	------	------	------	------	------
1894	Tulare	1893	25.05	------	.37	.31	------	------	------	------	------
	Average, Tulare	------	**24.75**	------	**.35**	**.31**	------	------	------	------	------
	BLACK TABLE-GRAPES.										
	Black Hamburg and Black Prince.										
781	Cupertino	------	24.70	24.64	.53	.44	12.82	.240	.45	.45	3.10
1265	Cupertino	------	15.87	------	.54	------	------	------	------	------	------
1699	Tulare	1887	24.10	------	.33	------	------	------	------	------	------
2003	Tulare	1890	23.70	22.40	.32	.50	10.75	.071	.33	.43	2.50
2347	Tulare	1892	23.70	------	.18	------	------	------	------	------	------
1956	Paso Robles	1893	25.20	24.12	.42	.38	11.82	.102	.42	.46	2.80
	Average, Cupertino	1894	**20.28**	**24.64**	**.53**	**.44**	**12.82**	**.240**	**.45**	**.45**	**3.10**
	Average, Tulare	1893	**23.83**	**22.40**	**.28**	**.50**	**10.75**	**.071**	**.33**	**.43**	**2.50**
	Gros Colman.										
1269	Cupertino	1890	14.70	------	.57	------	------	------	------	------	------
1425	Mission San José	1890	21.95	------	.42	------	------	------	------	------	------
1932	Paso Robles	1893	15.20	------	.40	.33	------	------	------	------	------
1973	Tulare	1893	21.50	------	.41	.33	------	------	------	------	------

	Black Morocco.										
1351	Cupertino	1890	16.70	-------	.65	-----	-------	-------	-------	-------	-----
2024	Tulare	1893	20.20	-------	.45	-----	-------	-------	-------	-------	-----
	California Black Malvoisie.										
1478	Paso Robles	1891	22.80	-------	.55	-----	-------	-------	-------	-------	-----
1855	Amador station	1893	20.20	-------	.60	-----	-------	-------	-------	-------	-----
2194	Amador station	1894	23.40	-------	.59	-----	-------	-------	-------	-------	-----
2224	Amador station	1894	27.60	-------	.43	-----	-------	-------	-------	-------	-----
	Average, Amador station	-----	**25.60**	-------	**.54**	-----	-------	-------	-------	-------	-----
	Cornichon.										
1350	Cupertino	1890	17.20	-------	.68	-----	-------	-------	-------	-------	-----
2007	Tulare	1893	19.30	-------	.50	-----	-------	-------	-------	-------	-----
	Emperor.										
1349	Cupertino	1890	19.30	-------	.66	-----	-------	-------	-------	-------	-----
2236	Mission San José	1894	15.40	-------	.72	-----	-------	-------	-------	-------	-----
	RED TABLE-GRAPES.										
	Barbarossa.										
746	Cupertino	-----	24.60	23.61	.47	.42	12.64	-------	-------	.52	2.60
1266	Cupertino	1887	22.90	-------	.58	.27	-------	-------	-------	-------	-----
2088	Cupertino	1890	24.80	-------	.77	-----	-------	-------	-------	-------	-----
1429	Mission San José	1893	28.50	-------	.44	-----	-------	-------	-------	-------	-----
1775	Mission San José	1890	22.85	23.13	.59	-----	11.64	-------	-------	.65	2.44
1995	Mission San José	1892	24.80	-------	.52	-----	-------	-------	-------	-------	-----
2230	Mission San José	1893	22.80	-------	.48	-----	-------	-------	-------	-------	-----
1740	Paso Robles	1894	24.80	-------	.37	-----	-------	-------	-------	-------	-----
1980	Tulare	1892	21.50	20.69	.47	.30	10.25	-------	-------	.45	2.80
	Average, Cupertino	1893	**24.10**	**23.61**	**.61**	**.35**	**12.64**	-------	-------	**.52**	**2.60**
	Average, Mission San Jose	-----	**26.38**	**23.13**	**.53**	-----	**11.64**	-------	-------	**.65**	**2.44**
	Flame Tokay.										
1928	Natoma	1893	19.50	-------	.36	-----	-------	-------	-------	-------	-----
	WHITE TABLE-GRAPES.										
	Luglienga.										
1210	Fresno	1890	20.85	-------	.32	-----	-------	-------	-------	-------	-----
1214	Fresno	1890	20.85	-------	.33	-----	-------	-------	-------	-------	-----
1305	Cupertino	1890	24.25	-------	.34	-----	-------	-------	-------	-------	-----

Summary of Analyses of Musts and Wines of Raisin, Table, and Other Grapes—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric.		Body
									At Pressing	At 6 to 8 Months	
	Luglienga—Continued.										
2087	Cupertino	1893	28.00	--------	.35	-----	--------	--------	--------	--------	------
1441	Tulare	1891	23.70	--------	.36	-----	--------	--------	--------	--------	------
1812	Amador station	1893	21.10	--------	.47	-----	--------	--------	--------	--------	------
	Average, Fresno	------	**20.85**	--------	**.33**	-----	--------	--------	--------	--------	------
	Average, Cupertino	------	**22.13**	--------	**.34**	-----	--------	--------	--------	--------	------
	Pizzutello di Roma.										
2006	Tulare	1893	22.20	--------	.38	-----	--------	--------	--------	--------	------
	Almeria.										
2023	Tulare	1893	19.70	--------	.54	-----	--------	--------	--------	--------	------
	AMERICAN TYPE.										
	Herbemont.										
1386	Cupertino	1890	22.40	--------	.69	-----	--------	--------	--------	--------	------
2125	Cupertino	1893	24.40	--------	.85	-----	--------	.163	.90	--------	------
1749	Paso Robles	1892	23.70	--------	.56	-----	--------	--------	--------	--------	------
1767	Mission San José	1892	21.30	--------	1.05	-----	--------	--------	--------	--------	------
2001	Tulare	1893	20.20	--------	.76	.37	9.27	.134	.75	.52	3.00
	Average, Cupertino	------	**23.40**	--------	**.60**	-----	--------	**.163**	**.90**	--------	------

NOTES ON RECENTLY IMPORTED GRAPES.

Of the most recently imported grapes in the collection obtained from Count S. di Rovasenda, of Turin, some varieties have commenced to bear at the Pomona and Tulare stations. At present but a partial report can be made on the character of their fruit and their adaptability to conditions existing in California; but the following notes are given for the benefit of those who have received cuttings of these varieties. They are principally Italian grapes, many from northern Italy (whence we have already obtained some of our most promising varieties), but others from Sicily, Sardinia, and southern Italy—localities whose grapes are as yet quite untried in California.

All the varieties have grown vigorously at Berkeley, where, however, they have all failed to mature any fruit. Their unsuitableness to cool localities is well illustrated in Berkeley by their failure to ripen perfectly their wood side by side with French varieties, nearly all of which mature their canes without difficulty.

Pelaverga (syn., Cari).—Robust and productive; bunches large; berries large, reddish-black, very sweet, and keeping well through the winter. Used for the production of a sweet, sparkling wine in the country around Saluzzo, but more suitable for a table-grape than for wine.

Zinzillosa (syn., Tintorina).—Resembles the Mourastel.

Bolgnino (syn., Nebbiolo di Dronero).—Cultivated near Saluzzo, in Piedmont, and differing very much from the true Nebbiolo. This variety has fruited at Tulare, and a sample of the grapes was received from there on October 14, 1895, in good condition. The must showed 24.6% of solid contents by spindle and 0.48% of acid. The bunches were small, compact, cylindrical, on heavy peduncles; the berries small, round, juicy, sweet, and of good flavor. A few of the grapes were sun-dried, and in general they resembled a Pinot.

Crovattina (syn., Croattina, Nebbiolo di Gattinara).—Grown in various parts of Piedmont and Lombardy. It has large, round, black berries, resembles the Bonarda more than the Nebbiolo, and gives a common wine of good color. It is a heavy bearer, but needs a deep soil.

Negrara di Gattinara.—A black wine-grape, cultivated in the extreme north of Piedmont.

Erbalus di Caluso.—It is from this grape that the liqueur wines of Caluso are made. On account of its thick skin and firm pulp it is a good keeper and very suitable to partial drying before crushing, as is done in making the liqueur wines of Caluso. It is not a heavy bearer, and requires long-pruning.

Description: Leaves of medium size, thin and smooth, dark green and slightly tomentose on the lower surface, sharply toothed, and deeply five-lobed; bunches cylindrical and with small wings; berries of medium size, round, thick-skinned, yellowish at first, becoming rose-colored.

This variety has fruited at the Pomona station, and on September 14, 1895, a sample of the grapes was received in good condition. The must showed 23.0% of solid contents by spindle and 0.62% of acid. The bunches were of medium size, cylindrical, well filled, on slender peduncles; the berries of medium size, nearly round, pulpy but soft, thick-skinned, from green to pink in color, on short, slender pedicels, not of very agreeable flavor, but mature and having good acid.

Grisa di Piemonte.—A valued table-grape of northern Italy. The bunches are large, conical, and well filled; the berries large, slightly oval, pulpy but soft, black, but grayish in appearance on account of their abundant bloom.

Antibo.—A large, black table-grape of Saluzzo, Piedmont. The grapes are said to be very crisp and agreeable.

Quagliano.—A large, black table-grape grown in the neighborhood of Cuneo, Piedmont, in light soils. It is of very delicate and agreeable flavor. A sample of the fruit of this variety was received from the Tulare station on October 14, 1895, in good condition. The must showed 23.9% of solid contents by spindle and 0.38% of acid. The bunches were of medium size, conical, and well filled; the berries large, round, crisp, rather astringent, of good flavor, and with tender skin. It was a very pleasing and fine looking table-grape, but not firmly enough attached to the pedicel for distant shipment. It resembled the Gros Colman.

Bermestia Rossa or Violetta.—A large table-grape cultivated in Lombardy and other parts of northern Italy. The bunches are large, loose, long, conico-cylindrical, on long, slender peduncles; the berries very large, long-olive-shaped, on long, slender pedicels; the skin is thick, violet-red; the flesh firm and of neutral flavor.

Bitondo.—A grape grown on the Adriatic side of central Italy. The grapes are large, round, of brick-red color; the bunches on long peduncles with distinct wings.

Malvasia Rovasenda.—A seedling originated by Baron Mendola, of Favara, Sicily.

Malvasia di Broglio.—Grown in Tuscany and Apulia, and in many other parts of Italy. It is a vigorous grower and good bearer, and resists the *oidium* well. A sample of the grapes was received on September 27, 1895, in good condition. The must showed 25.9% of solid contents by spindle and 0.45% of acid. The bunches were large, irregular, with many long cylindrical branches, well filled; the berries were small, round, firm, fleshy, with little flavor, resembling the Sherry grapes in character.

Negro Amaro (syn., Lacrima).—A wine variety of Apulia; said to be too late for northern Italy. A sample was received from Tulare in good condition. The must showed 25.9% of solid contents by spindle and 0.65% of acid. The bunches were of medium size, conico-cylindrical, compact, on heavy peduncles; the berries of medium size, slightly oblong, firm, juicy, thick-skinned, with fair color, of fresh and agreeable flavor. The grapes resemble the Chauché noir, but have better color and more flavor.

Cesanese.—A vine of central Italy, with black, oval grapes.

Trivoti.—A vine cultivated in Sicily. The grapes are large, ellipsoidal, light violet or marked with reddish-brown blotches.

Negro Dolce.—A vine cultivated in Apulia.

Catarrattu a la Porta.—A white grape of Sicily, which enters into the manufacture of the wines of Marsala. It has large, round, yellow berries, and bears well.

Mammolo Toscano.—Said to give a wine having a faint flavor of violets. It is cultivated in Tuscany, and is rather too late for more northern localities. The grapes are oval and black.

Pagadebito.—This name, which means "pay debt," is given to several heavy-bearing grapes in various parts of Italy. The one planted at the Experiment Stations seems to be the Pagadebito which occupies a large part of the vineyards along the whole Adriatic slope of the Apennines. It is vigorous, robust, and bears well. A sample of the grapes was received from Tulare on October 14, 1895, in good condition. The bunches were small, cylindrical, well filled, each with a small wing; the berries small, round, juicy, firm, with very thick and astringent skin, good color and flavor, but lacking in acid. Many of the berries were small and abortive. The must showed 21.7% of solid contents by spindle and 0.41% of acid.

Vernaccia Sarda (syn., Austera).—A heavy-bearing white-wine grape of Sardinia. It gives a lighter wine than most of the vines of Sardinia, and is very agreeable, though somewhat rough and a little bitter.

Monica (syn., Munica, Nectarea).—This variety produces the most valued wine of Sardinia. It is a strong grower, somewhat resembling the Mission. A sample of the grapes was received from Tulare on October 15, 1895, in good condition. The bunches were very large, conical, heavily shouldered, well filled; the berries over medium, round, firm, well attached to the pedicel, of good flavor and very sweet, of a dull brownish-purple color. It is an agreeable eating-grape and probably a good shipper, on account of its beautiful bunches, which, though very large, adapt themselves well to packing. The must showed 27.4% of solid contents by spindle and 0.24% of acid.

Ocru di Boe.—A black grape of Sardinia. It has large, conico-cylindrical bunches, very large, oval berries, which are firm, thin-skinned, and of good flavor. It ripens late.

Cipro Nero.—From this grape the most famous wine of the Island of Cypress is made. A sample of the fruit was received from Tulare on October 14, 1895, in good condition. The bunches were of medium size, loose, on slender peduncles; the berries large, ovoid, firm, with thick but tender skin, and good flavor. It appeared to be a good shipping-grape, somewhat resembling the Black Prince, but with less color and more flavor. The must showed 23.0% of solid contents by spindle and 0.42% of acid.

Danugue (syn., Gros Guillaume).—A late table-grape of southern France. The bunches are large, branching, and loose; the berries large, ellipsoidal, firm, juicy, of neutral flavor, and with a very thick, tough skin, of dull black color.

Olivette de Cadenet (syn., Teneron).—A good late table-grape. A sample of the fruit was received from Pomona on September 14, 1895, in good condition. The bunches were large, loose, long-conical, on slender peduncles; the berries large, ellipsoidal, firm, fleshy, with thick but tender skin, and little flavor. Apparently an excellent shipping-grape of green to yellowish color.

Picpoule.—This is one of the most widely cultivated grapes of the south of France. It is a heavy bearer and especially adapted to close, head pruning. Its bunches are of medium to large size, conico-cylindrical, winged; the berries are nearly round and of medium size. It was the principal black grape of Languedoc until it was abandoned in favor of the Aramon, on account of its extreme liability to attack of *oidium.* Now that the *oidium* is successfully combated by sulphur, this variety may be worth trying in California, on account of its vigor, fertility, and adaptability to poor soils.

Aspiran noir.—This is the white variety of the Verdal, and is more esteemed in France than the latter, both for wine-making and for the table.

Persan.—This is one of the most valued grapes of Isère and Savoy for red wine. It is, however, generally considered inferior to the Etraire de l'Adhui, which it resembles closely.

Chenin noir.—This is one of the chief red-wine grapes of the department of Maine-et-Loire, in the west of France, where it gives good crops, but ripens rather late.

WINES RECEIVED FOR EXAMINATION.

RED WINES.

No. 1208R. *Cabernet Sauvignon*, from Jos. Sladky, Mountain View; received February 14, 1890. Condition good, color light for the variety, acid slightly deficient.

No. 1632R. *Cabernet Sauvignon*, vintage of 1885, from Wm. Pfeffer, Gubserville; received and analyzed April 1, 1892. Color much less than in the following samples of Cabernets from the same place; 19.10 in intensity and verging toward yellow in tint.

No. 1633R. *Cabernet Sauvignon*, vintage of 1887, from Wm. Pfeffer, Gubserville; received April 1, 1892. Color much more intense than in the 1885 sample, 34.80 as against 19.10 for the earlier vintage.

No. 1640R. *Cabernet Sauvignon*, vintage of 1889, from Wm. Pfeffer, Gubserville; received April 1, 1892. Color, 38.10 in intensity; tint, red.

No. 1634RI. *Cabernet Sauvignon*, vintage of 1890, from Wm. Pfeffer, Gubserville; received April 1, 1892. Color, V.R.—63.5.

No. 1635RII. *Cabernet Sauvignon*, vintage of 1890, from Wm. Pfeffer, Gubserville; received April 1, 1892. Color, V.R.—60.6; taste, intensely "tannic." Apart from the sugar still present, the wine is heavy-bodied. The alcoholic contents of this wine having nearly reached the possible limit, the wine hardly runs any risk from the sugar that it contains.

No. 1636R. *Cabernet Sauvignon*, vintage of 1891, from Wm. Pfeffer, Gubserville; received April 1, 1892. Color, V.R.—83.3.

No. 2582. *Cabernet Sauvignon*, vintage of 1889, from Wm. Pfeffer, Gubserville. Condition good; color bright; body high; wine contains a considerable amount of carbonic acid gas.

No. 2596. *Cabernet Sauvignon*, vintage of 1893, from Wm. Pfeffer, Gubserville; received February 28, 1894. Pomace was taken away from must two days after crushing. Color, 4V.R.—30.5; body and color, light; a tart, pleasant wine. The effect of early drawing off from the pomace in reducing the tannin contents of the wine is well shown in this wine.

No. 2597. *Cabernet Sauvignon*, vintage of 1893, from Wm. Pfeffer, Gubserville; received February 28, 1874. Fermented on ¼ pomace. Wine somewhat rough; color more bluish than No. 2596, and read 2V.R.—61.50.

No. 2618. *Cabernet Sauvignon*, vintage of 1891, from Grau & Werner, Irvington, Alameda County; received July 16, 1895.

Nos. 2584–88, 2593–94. *Cabernet Sauvignon*, from T. Parrott, St. Helena. No. 2584 is from the vintage of 1889; No. 2585, vintage of 1890; No. 2586, vintage of 1891; No. 2587, vintage of 1892; No. 2588, vintage of 1893; No. 2593, vintage of 1893 (press wine); No. 2594, vintage of 1893.

The above seven samples of Cabernet Sauvignon wines were received from the late Tiburcio Parrott, of St. Helena, Napa County, on October 6, 1893. They were obtained with the object of showing that California wines made from the typical Medoc varieties of grapes, even wines which are acknowledged to be among the best of their class, are always excessively rich in tannin; that is to say, their astringency is much higher than that of the French Medocs of commerce. A comparison of the analyses of these wines with some recent analyses made by Messrs. N. Gayon, Ch. Blarez, and E. D. Dubourg, of the University of Bordeaux, is very instructive. In twenty-one of the best wines of the Medoc region they found the tannin to range from 0.190% to 0.270%, the average being 0.210%. As the table shows, the St. Helena wines ranged from 0.385% to 0.573%, and averaged 0.483%, which is more than twice as much as is shown by the French Medocs. This explains very clearly why our finest Cabernet Sauvignon wines are not appreciated by many who are used to the smoother French clarets. The mistake made by our wine-makers is in supposing that, to produce a wine of the character of the finest Château wines, they must keep the high-class Medoc grapes undiluted with any grapes of inferior quality. The fact is that all French Medocs are made by blending the highly characterized wines with smoother and more neutral ones. This is generally done in the fermenting-vat, but very often in the cellars, of the Bordeaux wine-handlers.

The finer the quality of a pure Cabernet Sauvignon wine, the more intensified, very often, are its characteristics. It should be looked upon as a concentrated liquid, almost an essence, containing all desirable ingredients, but in too condensed a form to be agreeable to the palate or to be used as a regular table-wine; but to be used to obtain the exact kind of wine desired by the average consumer, by means of blending with clean, fresh-tasting wines of similar but less marked character. It might not be amiss to call attention to the fact that perhaps a great part of the popularity of the Zinfandel is due to the fact that the absolute and relative amounts of its various ingredients generally approach more closely, naturally without blending, to the genuine Claret type than do other varieties which in other respects are much superior to it.

No. 2620. *Cabernet blend*, from Grau & Werner, Irvington, Alameda County; received July 16, 1895.

Nos. 2621 and 2622. *Zinfandels*, vintages of 1893 and 1894, respectively; samples sent by Grau & Werner, Irvington, Alameda County; received July 16, 1895.

The analyses of samples Nos. 2618, 2620, 2621, 2619, and 2622, given in the table, represent the normal composition of wines made from grapes grown on the uplands lying between Mission San José and Irvington, California; well known for the quality of their products. They are pure, natural wines; the small amount of boracic acid shown being derived from the soil which in the northern part of this State always contains more or less of this ingredient, and which is taken up by the vine here, as in Tuscany, Italy.

No. 1207R. *Blend of Cabernet Sauvignon and Malbeck*, from Wilkins & Co.; received February 1, 1890.

No. 1631R. *Verdot*, vintage of 1891, from Wm. Pfeffer, Gubserville; received April 1, 1892. Color, 2V.R.—129.3. A heavy-bodied wine apart from the sugar which it still contains; but there is no obvious reason why this wine should not have fermented out. The acid is very high, yet it does not appear so to the tongue, because of the sugar and tannin, which interfere with its perception. No unsound germs are yet present, however.

Nos. 1637R and 1638R. *St. Macaire*, of vintage of 1890 and 1891, respectively; samples sent by Wm. Pfeffer, Gubserville; received April 1, 1892. No. 1637R, color 2V.R.—57.90; No. 1638R, color V.R.—80.00.

No. 1639R. *Mondeuse*, vintage of 1891, from Wm. Pfeffer, Gubserville; received April 1, 1892. Color, 2V.R.—49.4.

The wines of the district represented by Gubserville are favored with a very unusual amount of tannin. There need be no doubt that the St. Macaire, in this locality, is a genuine Bordeaux, or Claret grape, for both in acid and in tannin it comes fully up to the type, the Cabernets.

Nos. 1622R and 1623R. *Zinfandels*, vintage of 1890, respectively first and second crop; sent by A. Salazar, Mission San José. The wines were examined as to differences in acid, and the result indicates there was no perceptible difference.

No. 1624R. *Blend of Mataro and Zinfandel*, vintage of 1888; sample sent by A. Salazar, Mission San José, April 22, 1891. It contained 0.69% of total acid as tartaric, and 0.09% of volatile acid.

No. 2591. *Alicante Bouschet*, vintage of 1893, from I. de Turk, Santa Rosa; sample received and analyzed December 20, 1893.

No. 2592. *Petit Pinot*, vintage of 1893, from I. de Turk, Santa Rosa; received December 20, 1893.

No. 2599. *Black Pinot*, vintage of 1889, from P. B. Cornwall, Santa Cruz; received and analyzed for acid August 27, 1894.

No. 1218R. *Malvasia*, vintage of 1890, from H. W. Crabb, Oakville; received February 26, 1891. Samples of wines from two tanks, which showed at crushing on October 25, 1890, 40% of sugar; they were crushed cold and have fermented very slowly, still showing 10% and 12% of sugar, respectively.

WHITE WINES.

No. 1204R. *Blend of Chauché gris and Chauché noir*, vintage of 1889, from Wilkins & Co. Wine quite turbid; color light amber; bouquet characteristic; acid not high, but leaves a slight roughness in the throat; taste alcoholic. A microscopic examination of the sediment showed some lactic and a few "effete" yeast germs.

No. 1205R. *Blend of white wines*, vintage of 1889, from Wilkins & Co.; received and analyzed February, 1890. Condition turbid; color pink-red; acid medium; taste not sweet. A microscopic examination of the sediment of the wine showed a very little acetic ferment and some lactic germs, as well as dead yeast-cells.

No. 2595. *Pedro Jimenes*, from J. Bergin, Mountain View; received February 27, 1894.

No. 2628. *Sauvignon vert*, vintage of 1895, from R. Schmidt, Calistoga; received and analyzed February 14, 1896.

No. 2624. *Sauvignon blanc*, vintage of 1893, from G. F. Merriam, Twin Oaks, San Diego County.

No. 2625. *Sauvignon blanc*, vintage of 1894, from G. F. Merriam, Twin Oaks, San Diego County.

No. 2626. *Sauvignon blanc*, vintage of 1895, from G. F. Merriam, Twin Oaks, San Diego County.

The above three wines, though made from Sauvignon blanc, were in no sense Sauternes, but were fortified wines with high sugar contents, which conformed to no type, but were fairly agreeable liqueur wines.

No. 2676. *Riesling*, vintage of 1895, from R. Schmidt, Calistoga; received and analyzed February 14, 1896.

Nos. 1202R and 1203R. *Rieslings*, vintages of 1888 and 1889, respectively; sent by W. G. Klee, January 6, 1890, from Glenwood, Cal. No. 1202R wine in good condition, smooth taste and clean; acid pleasant, but high. No. 1203R wine had fine aroma and high acid; was rendered very pungent by large contents of carbonic acid gas.

No. 2583. *Green Hungarian*, vintage of 1892, from Geo. Husmann, Napa; received and analyzed August 24, 1893.

Nos. 2576 and 2577. *Sauvignon vert*, from F. Sierus, Rutherford, Napa County. Both sound and clean-tasting wines of bright condition and pleasant acid. No. 2577 of more pronounced bouquet and flavor than No. 2576, which, on the whole, does not promise to be a wine of as high quality as No. 2577.

MISCELLANEOUS PRODUCTS.

The nature of the request which accompanied each sample will be understood by the description given. The results of analyses and methods of treatment are detailed under each number as it occurs.

No. 1209. *Champagne*, from Wm. Rueff, San Francisco; received and analyzed February 14, 1890. The sample contained a troublesome black sediment, which, when examined microscopically, showed no definite form. Upon heating the wine the sediment apparently dissolved. Tests showed the presence of lead, but no tin.

No. 2614. *Sample of Wine*, from Santa Clara Valley; thought to be "over fined." The wine showed 0.268% of albuminoids (nitrogenous matter); not an amount in excess of that usually contained in wines of its kind.

No. 2598. *Orange Wine*, from Kinton Stevens, Santa Barbara; received August 13, 1894. The sample contained 17.50% of alcohol by volume, 0.44% of citric acid, and 3.30% of solids. Orange wine is essentially a fortified wine, which may or may not retain a taste of orange peel, according to the methods used in the manufacture. The above sample resembled Sherry and bore no trace of orange peel to the taste. Owing to the amount of labor necessary in the manufacture of this wine, the amount of sugar and acid necessary to be added, as well as of alcohol, this industry does not seem to be profitable. By crushing the skins and not peeling the oranges, a very agreeable liqueur can be made at less expense than the dry orange wine.

No. 1619. *Sherry*, from Santa Clara Valley. A small sample was received April 1, 1891. The wine had become bitter from treatment with powdered limestone. Its total acid content as tartaric was determined to be 0.25%. Upon the addition of carbonate of soda to the extent of 0.25% the wine showed no precipitate of lime and still had an acid reaction. Double the above amount of carbonate of soda was added, when a large precipitate of lime appeared; this was allowed to settle and the clear wine aërated; a little more fine precipitate appeared. This experiment certainly lessened the *bitterness*, but the soda gave a *mawkish* taste to the wine.

No. 1620. *Sherry*, from Santa Clara Valley; received April 7, 1891. A larger sample of the same wine as No. 1619, but containing a little more acid, or 0.32% represented as tartaric acid; fully one third of this acid was acetic acid. This sample was treated with a slight excess of potassium carbonate, which produced a voluminous light brown precipitate—largely lime. After aërating the clear liquid and allowing the small precipitate thus produced to settle out, the acid was brought to its original amount by the addition of tartaric acid. This experiment rendered the Sherry smooth and not nearly so bitter as when received. By treating the wine with a slight excess of carbonate of potash, removing the resulting precipitate either by filtration or racking, and then bringing the total acid to 0.52% as tartaric, by the addition of that acid, the Sherry was rendered smooth and all the bitterness apparently disappeared.

No. 2600. *Prune Juice;* sample received October 8, 1894, from Prof. Rising, requesting the percentage of alcohol, which was found to be 17.10% by volume.

No. 2602. *Vinegar*, from R. E. Beckweth, Fresno; received November 29, 1894. This sample was claimed to be pure cider-vinegar. It contained 7.29% of acetic acid—rather more than cider-vinegar, which commonly contains from 3.5% to 6.0%.

Nos. 2605 and 2611. *Vinegars*, from Jenison & Strine Bros., of Downey, Los Angeles County. These samples were sold for pure cider-vinegar. No. 2605 was received February 14, 1895, and contained 7.38% of acetic acid. No. 2611 was a larger sample of the same vinegar, and was received April 4, 1896; this yielded 8.07% of acetic acid, 0.74% of extract, and only traces of malic acid. This goes to show that the sample is not pure cider-vinegar, for the extract (0.74%) is just about one half the quantity contained in cider-vinegar; malic acid, a constituent of cider-vinegar, is almost lacking, and the high acetic acid content (8.07%) is over 2% more than the maximum acetic acid in cider-vinegar.

No. 2610. "*Unfermented Wine*," from W. S. Austin, San Diego, Cal.; received March 26, 1895. This wine was sold as a curative for throat and lung troubles. Upon opening the bottle a strong odor of sulphurous acid was noticed; when the sample was heated this acid was strongly evolved. The sample was found to contain 0.596 gram of sulphurous acid per liter (0.0596%), which amount is, of course, too great to be taken into any stomach. Besides the above work this wine was tested for salicylic and boracic acids; however, neither of these antiseptics was present. The liquid showed 22.0% of solid contents and 0.588% of total acids reckoned as tartaric acid. These "unfermented wines" are getting to be quite common in the State. As a matter of fact, they are not wines at all, but merely grape juice, to which some powerful antiseptic has been added; in many cases salicylic acid, boracic acid, etc., are used. So far as is known, the only "unfermented wines" that are not apt to contain injurious additions are those in which the fermentation has been prevented by the use of heat—pasteurization. The "secret process" of making these so-called "wines" often means that if the ingredients were known, the sale of the "wine" would be impossible.

No. 2629. *Norton's Virginia Seedling Wine*, from Wm. Hotopp, Penn Park Vineyards, Charlottesville, Virginia. This sample was obtained in Virginia by Mr. James P. Langhorne, of San Francisco, and was given to the University for testing. The importance of the sample arises from the fact that the wine is made from "Norton's Virginia," a hybrid that has been highly spoken of as a direct producer—that is to say, a vine that not only resists the phylloxera, but also, without grafting, yields grapes that are said to make good wine. It was found that although the wine was better than that made from most of the American hybrids, such as the Herbemont, etc., yet the "foxy" or musky taste was so prominent as to preclude its use as a true Claret grape. The characteristic "dropping of color" after the wine was made was as strong as noted in the case of wine made from the Lenoir; while the excess of tannin and marked harshness made it a wine that would be useless on the markets of any part of the world, except the locality where it originated, and where the people have become accustomed to these peculiar flavors and aromas. Already in this State "Norton's Virginia" has been highly recommended by some, both as a stock and as a direct producer. Its feeble resistance to the phylloxera when moved from its native habitation, and its peculiarities of taste, however, render it a useless variety for California.

ANALYSES OF WINES SENT TO THE STATION FOR EXAMINATION.

Serial Number	Variety and Vintage.	Sender.	Place of Production.	Date of Analysis.	Alcohol.		Tannin	Acid.		Body, or Solids	Sugar	Ash
					By Weight	By Volume		Total as Tartaric	Volatile as Acetic			
	RED WINES.											
	Dry Red Wines.											
1208R	Cabernet Franc	Jos. Sladky	Mt. View, Santa Clara Co.	Feb. 14, 1890	9.78	12.18	.195	.38		2.70		
1632R	Cabernet Sauvignon, 1885	Wm Pfeffer	Gubserville	April 1, 1892	10.81	13.27	.360	.67		3.10		
1633R	Cabernet Sauvignon, 1887	Wm. Pfeffer	Gubserville	April 1, 1892	11.23	13.73	.424	.64		2.55		
1640R	Cabernet Sauvignon, 1889	Wm. Pfeffer	Gubserville	April 1, 1892	11.23	13.73	.402	.59		2.60		
1634R	Cabernet Sauvignon, 1890	Wm. Pfeffer	Gubserville	April 1, 1892	10.81	13.25	.405	.55		2.05		
1635R	Cabernet Sauvignon, 1890	Wm. Pfeffer	Gubserville	April 1, 1892	12.54	15.40	.573	.49		3.23	0.22	
1636R	Cabernet Sauvignon, 1891	Wm. Pfeffer	Gubserville	April 1, 1892	11.54	14.10	.516	.48		2.80		
2582	Cabernet Sauvignon, 1892	Wm. Pfeffer	Gubserville	Aug. 16, 1893	9.34	11.64	.408	.47		2.60		
2584	Cabernet Sauvignon, 1889	T. Parrott	St. Helena	Oct. 6, 1893			.448	.63				
2585	Cabernet Sauvignon, 1890	T. Parrott	St. Helena	Oct. 6, 1893			.573	.57				
2586	Cabernet Sauvignon, 1891	T. Parrott	St. Helena	Oct. 6, 1893			.448	.67				
2587	Cabernet Sauvignon, 1892	T. Parrott	St. Helena	Oct. 6, 1893			.488	.44				
2588	Cabernet Sauvignon, 1893	T. Parrott	St. Helena	Oct. 6, 1893	9.78	12.20	.495	.53				
2593	Cabernet Sauvignon, 1893	T. Parrott	St. Helena	Dec. 20, 1893			.544					
2594	Cabernet Sauvignon, 1893	T. Parrott	St. Helena	Dec. 20, 1893			.384					
2590	Cabernet Sauvignon, 1893	I. De Turk	Santa Rosa	Dec. 20, 1893			.502					
2596	Cabernet Sauvignon, 1893	Wm. Pfeffer	Gubserville	Feb. 28, 1894	11.62	14.20	.208	.49		2.70		
2597	Cabernet Sauvignon, 1893	Wm. Pfeffer	Gubserville	Feb. 28, 1894	12.77	15.70	.307	.60		2.60		
2618*	Cabernet Sauvignon, 1891	Grau & Werner	Irvington	July 16, 1895	9.66	12.05		.68	.07	2.80	0.17	.22
1207R	Blend (Cabernet Sauvignon and Malbeck)	Wilkins & Co.		Feb. 1, 1890				.37		2.70	0.00	
2620*	Cabernet blend	Grau & Werner	Irvington	July 16, 1895	10.21	12.80		.64	.08	2.71	0.13	.25
1637R	St. Macaire, 1890	Wm. Pfeffer	Gubserville	April 1, 1892	11.08	13.54	.538	.60		2.85		
1638R	St. Macaire, 1891	Wm. Pfeffer	Gubserville	April 1, 1892	9.92	12.36	.456	.47		3.00		
1639R	Mondeuse, 1891	Wm. Pfeffer	Gubserville	April 1, 1892	10.91	13.36	.471	.47		2.55		
1631R	Verdot, 1891	Wm. Pfeffer	Gubserville	April 1, 1892	10.35	12.82	.420	.86		3.02	0.58	
1622R	Zinfandel, 1890 (first crop)	A. Salazar	Mission San José	April 22, 1891				.66				
1823R	Zinfandel, 1890 (second crop)	A. Salazar	Mission San José	April 22, 1891				.65				

2589	Zinfandel, 1893	I. De Turk	Santa Rosa	Dec. 20, 1893			.291					
2621*	Zinfandel, 1893	Grau & Werner	Irvington	July 16, 1895	10.14	12.70		.57	.06	2.68	0.16	.22
2622*	Zinfandel, 1894	Grau & Werner	Irvington	July 16, 1895	10.21	12.80		.57	.13	3.24	0.31	.23
1624R	Blend (Mataro and Zinfandel), 1888	A. Salazar	Mission San José	April 22, 1891				.69	.09			
2591	Alicante Bouschet, 1893	I. De Turk	Santa Rosa	Dec. 20, 1893			.445					
2592	Petit Pinot, 1893	I. De Turk	Santa Rosa	Dec. 20, 1893			.361					
2599	Black Pinot, 1889	P. B. Cornwall	Santa Cruz	Aug. 27, 1894				.42				
2619*	Petit Pinot, 1891	Grau & Werner	Irvington	July 16, 1895	9.98	12.60		.68	.11	2.70	0.14	.26
1218R	Malvasia (tank No. 1, tank No. 2), 1890	H. W. Crabb	Oakville	Feb. 26, 1891	10.50 10.52	13.90 13.81				16.10 14.70		
	Unclassified Red Wines.											
1206R	Mixed reds	Wilkins & Co.		Feb. 18, 1890				.40		2.60		
1629R	Red wine	M. Baumard	San Francisco	Dec. 4, 1891	10.80	13.91				7.30		
2579	Red wine	Solis Wine Co.	Gilroy	June 28, 1893				.49	.07			
2580	Red wine	Solis Wine Co.	Gilroy	June 28, 1893				.64	.13			
2581	Red wine	Solis Wine Co.	Gilroy	June 28, 1893				.65	.08			
2603†	Red wine	J. H. Hague	Gilroy	Dec. 10, 1894				1.42	.74	9.10	3.25	
2604‡	Red wine	J. H. Hague	Gilroy	Dec. 10, 1894				.98	.10	4.60	.25	
2606	A, red wine	Solis Wine Co.	Gilroy	Feb. 18, 1895			.169	.60	.18	2.70	trace	
2607	B, red wine	Solis Wine Co.	Gilroy	Feb. 18, 1895			.170	.61	.08	2.85	trace	
2608	C, red wine	Solis Wine Co.	Gilroy	Feb. 18, 1895			.215	.50	.07	2.70	trace	
2609	D, red wine	Solis Wine Co.	Gilroy	Feb. 18, 1895			.232	.40	.10	2.99	1.41	
2612	Red wine	J. A. Sladky	Mt. View	Apr. 4, 1895	10.69	13.25		.55		2.30		
2613	Red wine	W. E. Hague	Gilroy	May 9, 1895			.189					
1625R	Red wine	E. H. Guppy	San José	Apr. 29, 1891	10.63	13.09				2.60		
2615	Red wine blend	Grau & Werner	Irvington	June 25, 1895	9.70	12.09		.53				
2616	Red wine blend	Grau & Werner	Irvington	June 25, 1895				.72	.15			
2617	Red wine blend	Grau & Werner	Irvington	June 25, 1895	9.63	12.00		.65	.19			
2623	Red wine	W. E. Hague	Gilroy	Nov. 4, 1895	10.28	12.75		.70		2.60		
2630	Red wine, 1891	Solis Wine Co.	Gilroy	Apr. 16, 1896						2.60	trace	
2631	Red wine, 1893	Solis Wine Co.	Gilroy	Apr. 16, 1896						2.50	trace	
2632	Red wine, 1892	Solis Wine Co.	Gilroy	Apr. 16, 1896						2.60	trace	
2633	Red wine, 1892	Solis Wine Co.	Gilroy	Apr. 16, 1896						2.60	trace	
2629	“Virginia Seedling”	Wm. Hotopp	Charlottesville, Va.	Mar. 11, 1896	8.23	11.45	.490	.79		3.10		
	Ports.											
1615R	Port	J. Gallegos	Mission San José	Feb. 7, 1891	15.49	19.49				5.60		
1616R	Port	J. Gallegos	Mission San José	Feb. 13, 1891	13.45	17.20				8.55		
1617R	Port	M. M. Watson	Oakland, Cal.	Feb. 26, 1891	14.82	18.22				9.05		
1626R	Port	Barton Estate Co.	Fresno	Nov. 7, 1891	12.56	16.24	.248	.50		1.68	9.22	.28
1627R	Port	Barton Estate Co.	Fresno	Nov. 7, 1891	15.38	19.78	.346	.41		1.66	9.04	.21
2578	Port	Barton Estate Co.	Fresno	June 5, 1893	18.30	23.58				11.70		
2601§	Port	Barton Estate Co.	Fresno	Oct. 9, 1894		19.00		.93	.38	9.50		

ANALYSES OF WINES SENT FOR EXAMINATION—Continued.

Serial Number	Variety and Vintage.	Sender.	Place of Production.	Date of Analysis.	Alcohol. By Weight	Alcohol. By Volume	Tannin	Acid. Total as Tartaric	Acid. Volatile as Acetic	Body, or Solids	Sugar	Ash
	WHITE WINES.											
2576	Sauvignon vert, 1895	F. Sievers	Rutherford, Napa Co.	June 20, 1895	9.92	12.36	-----	.47	-----	2.25	-----	-----
2577	Sauvignon vert	F. Sievers	Rutherford, Napa Co.	June 20, 1895	9.92	12.36	-----	.47	-----	2.10	-----	-----
2628	Sauvignon vert	R. Schmidt	Calistoga	Feb. 14, 1896	-----	-----	-----	-----	-----	2.28	1.12	-----
2624	Sauvignon blanc, 1894	G. F. Merriam	Twin Oaks, San Diego Co.	Feb. 6, 1896	-----	19.00	-----	-----	-----	4.60	-----	-----
2625	Sauvignon blanc, 1893	G. F. Merriam	Twin Oaks, San Diego Co.	Feb. 6, 1896	-----	16.00	-----	-----	-----	12.80	-----	-----
2626	Sauvignon blanc, 1895	G. F. Merriam	Twin Oaks, San Diego Co.	Feb. 6, 1896	-----	21.00	-----	-----	-----	13.10	-----	-----
2627	Riesling, 1895	R. Schmidt	Calistoga	Feb. 14, 1896	-----	-----	-----	-----	-----	2.10	1.00	-----
1202R	Riesling, 1888	W. G. Klee	Glenwood	Jan. 8, 1890	10.81	13.27	-----	.72	-----	2.20	-----	-----
1203R	Riesling, 1889	W. G. Klee	Glenwood	Jan. 8, 1890	8.48	10.58	-----	.85	-----	2.30	-----	-----
2583	Green Hungarian, 1892	Geo. Husmann	Rutherford, Napa Co.	Aug. 24, 1893	9.36	12.00	-----	.65	-----	1.80	-----	-----
2595	Pedro Jimenes	J. Bergin	Mt. View, Santa Clara Co.	Feb. 27, 1894	14.20	11.62	-----	.45	-----	2.30	-----	-----
1204R	Blend (Chauché gris and Chauché noir, 1889	Wilkins & Co.	-----	Feb. —, 1890	-----	-----	-----	.41	-----	2.10	-----	-----
1205R	Blend "White mixed"	Wilkins & Co.	-----	Feb. —, 1890	-----	-----	-----	.47	-----	2.10	-----	-----

* Boracic acid, well-marked test. † Mannite, 0.902. ‡ Mannite, 0.800. § Potasium sulphate, 0.39 per cent.

PART II.

Phylloxera; by A. P. Hayne.

Fermentation; by F. T. Bioletti.
1. General Principles of Fermentation.
2. Experiments with Pure and Selected Yeasts.
3. Fermentation at high temperatures with addition of various substances.
4. Experiments with color grapes.
5. Asaprol.

Nitrogen in Musts and Wines; by Geo. E. Colby.

Miscellaneous Notes; by F. T. Bioletti.
1. Preservation of Fresh Grapes.
2. Sunstroke of the Vine.
3. Botrytis Cinerea.

List and Contents of Viticultural Reports issued by the Experiment Station and the late Viticultural Commission.

PHYLLOXERA.

By A. P. Hayne.

There is, perhaps, no other insect known to man that has been as much written about as the phylloxera. Every language of the civilized world is represented in its bibliography. It is to be observed, however, that the most valuable and by far the most numerous works upon the phylloxera, and especially the means of combating it, are found in French literature. Although the first description of the insect was printed in English by Asa Fitch, State Entomologist of New York, and by the late lamented C. V. Riley, for many years Entomologist of the U. S. Department of Agriculture, and thus the insect was first observed and named by Americans, yet our literature on the subject is very limited indeed; the best works we have in English, as well as in most of the foreign languages, are either translations or résumés from the French. This is especially true of works describing the means of combating the insect. The reason for this peculiar state of affairs is that, though the phylloxera is an American insect, yet we never had to seriously consider it till long after it had destroyed millions of acres in other countries.

In answer to the question constantly asked by vine-growers, "What book on the phylloxera shall I read, and where can I get it?" let me say that the student not familiar with French should read the reports published by the College of Agriculture of the State University, and those of the late Viticultural Commission. There is no complete work published in English on the subject, but one must look through several publications or annual reports if he would gain all the information to be had. In these reports will be found sufficient details to gain a clear idea of the life-history of the phylloxera, as well as the means of combating it; and in these publications will be found a complete list of works published in all languages on the subject.

The most *incomplete* part of the literature, both American and foreign, is that which treats of resistant vines and their adaptation. The reason for this is, that the subject is so new that sufficient time has not elapsed to enable the authors to make use of complete returns from experimental vineyards and stations. It is the purpose of the College of Agriculture to embody in a special bulletin a summary of the knowledge thus far obtained, which will appear about December, 1896. In this the subject of resistant vines will be thoroughly discussed.

The viticultural staff of the College of Agriculture is always ready to answer questions relating to this or kindred subjects, as well as to make such inspection and investigation as may be called for.

Home of the Phylloxera.—The phylloxera is not a California insect; it was introduced into this State either directly from that part of the United States east of the Rocky Mountains, or indirectly from Europe after the trans-Atlantic invasion, or from both. It should be here noted that the day for theorizing by amateurs in this matter is passed. It has been established beyond the possibility of a rational doubt that the phylloxera has existed on the American vines in their native forests for ages. That it exists and has existed on these American vines proves that these vines really do resist the attacks of the insect under certain conditions; but not, as many claim, that the insect cannot live on the roots of the American resistant vines. The phylloxera is always found on certain Eastern wild vines, only these vines are not killed by the sting of the insect, as is the case with the non-resistant European and Asiatic species.

In speaking of American vines we do not mean to imply that all resist equally well, or that all are of the same practical value even though the absolute resistance be the same. Some of the species are practically of no value, owing to the difficulty of propagation, either from cuttings or graft. It must also be remembered that the vines that are natives of the Pacific Coast have not been exposed to the ravages of the phylloxera until within a very few years, and thus it is that the same conditions do not obtain here as in the East.

It being granted, then, that California has been invaded by the phylloxera, having before been free from it, we are led to study the behavior of the insect rather in those countries that, like California, have been *invaded;* countries in which the phylloxera has encountered conditions differing from those existing in its native breeding-place. More especially do we look to those countries which, like California, use only the *Vitis vinifera*, or European species, instead of resistant American species. We thus have a much wider field, and are enabled to profit by the many years of experience of those who have wrestled with the problem for a longer time and in a more serious manner than ourselves. We can thus begin where they left off, and avoid making the same mistakes and repeating the very same experiments and failures which they experienced nearly a quarter of a century ago. Logical as this may seem, there are still some viticulturists who scorn to look beyond the borders of their own vineyards. This spirit of self-sufficiency is most fatal to any rational progress; and the sooner people admit that they do not in reality "know it all," the better it will be for the vine interests of the country.

Aside from the practical means of combating the phylloxera, it is very useful for us to study the behavior of the insect immigrant, in order to get a good idea of its biological changes under new conditions. It is very certain that the vast interests at stake, as well as the greater number of years of acute affliction, have caused the Europeans to make the most careful and thorough study of the insect itself, and the means of combating it. In America, then, we must draw most of our information from abroad.

The History of the Phylloxera in California has been told so often that we will give but a brief résumé, referring those desiring further information to the publications referred to in the beginning of this article. It is to be noted that we in California behaved, in regard to the pest, just as did the inhabitants of other countries. At first we made light of it; then we refused to allow it to be known how serious the trouble was, regarding it as an insult to be told that the pest had infected our vineyards. This is noted to-day in certain vineyards, such as those of the

Champagne region in France. There, quite recently, the peasants resented the imputation so strenuously that it took regiments of soldiers to enforce the quarantine rules laid down by the Government. In California, though we have had no bloodshed, there was much ill feeling engendered; so much so that even to this day some refuse to accept the inevitable, or to listen to those who would assist them.

At the beginning of the invasion of the pest, the State University undertook the study of the local biology of the insect; and its work in this regard stands true to-day, and has been confirmed by the best scientists of the world. Numerous systematic experiments suggested by vine-growers, chemists, and entomologists as to the means of combating the terrible insect, were undertaken. Some misapprehension exists in the minds of many as to the object of an experiment, and it may be well to call attention to the fact that *experiments are sometimes as valuable when they fail as when they are successful;* indeed, it may be said that *experiments never fail to do good.* If a supposed remedy is thoroughly tried and found to be useless, the experiment is valuable in showing that practical men will waste time and money in trying it again. It is by this system of exclusion that good and true remedies are found. It is proper to allude to this, because much has been written by irresponsible parties tending to cast ridicule on experiments that did not result in finding a practical remedy; as though remedies were *ever* found at once without preliminary trials. Thus, it was at one time suggested abroad that, as the fumes of mercury are fatal to the phylloxera, it might be possible to utilize this as a means of combating the insect on the roots of the vine. A series of experiments were undertaken in every country in the world by the best scientists and practitioners. At first it appeared as though the proposed remedy might be practical, owing to a misconception of the amount of mercury and the time necessary to saturate the soil with its fumes. Systematic experiments showed that the quantity necessary was too great to admit of practical use in vineyards on a large scale; and because this did not prove a "sure cure," some ignorant persons made, and indeed are now making, an outcry against all experimentation.

Among other facts brought out by the systematic investigations made by the College of Agriculture was the fact that the winged form of the phylloxera (and hence the sexual form) is comparatively scarce in California. This led some dilettanti who desired to pander to the popular ideas to proclaim loudly that there was really no danger from the phylloxera. They said that it had been "localized," and that owing to "climatic conditions" it would not spread. While it is perfectly true that, for some reason, the winged form is rarer in California than elsewhere, it is none the less true that it does exist; and therefore that the phylloxera will continue to spread and multiply.

This was pointed out by the College of Agriculture years ago, but was disregarded. To-day the truth of the predictions then made is verified in only too striking a manner. That little attention was given to these warnings was due to several causes, the most powerful one being that the price of wine fell to so low a point that many vine-growers did not wait for the phylloxera to destroy their vineyards; but anticipated certain destruction by rooting out the vines and planting other crops. In this way many vineyards that never should have been planted were gotten rid of, and, so far as it went, this was an advantage.

There are several reasons why the phylloxera spreads more slowly in this State than in other countries. The fact that the winged form is very rare is among the chief; and hence that infection comes mainly from the wingless insects, which must be bodily carried by persons, wagons, boxes, or implements, and cuttings—adds materially to the efficacy of this impediment. In our dry atmosphere the swellings resulting from the bite of the phylloxera are not so quick to develop and spread over the surface of the roots; for it must be remembered that the injury by the phylloxera to the vines arises not so much from the amount of sap that it sucks from the roots or leaves, but mainly from the swellings that form where the insect inserted its sucking apparatus, and which start decay of the roots. The richness and freshness of our soils, together with the slower progress of decay, often enable a healthy, well-cared-for vine to throw out new roots almost as fast as the old ones are destroyed. This gives our vines a longer lease of life after being attacked than is the case in other countries; but it is none the less true that in the end they succumb to the fatal attack of the insect.

Soon after the outbreak of the phylloxera in California, the State entrusted the viticultural interests to a picked commission of vine-growers, and for fourteen years the field work was taken out of the hands of the College of Agriculture, owing to the absence of appropriations. Although it had no money for field investigations, the College staff was many times requested to make such investigations at the expense of parties desiring them; and it was during some of these that it was found that, so far from the phylloxera having been "localized," as had been said, the regular course of events had been followed, as had been predicted years before. That is to say, there had been no "localization" at all, but the insect had spread unchecked from region to region, and is still spreading wherever there are vines to live upon. Thus, it was found to have existed in the well-isolated Livermore Valley for years, although these vineyards had been pronounced uninfested. It was found all through the Santa Clara Valley, on the top of the Santa Cruz Mountains, in the Alhambra Valley in Contra Costa County, and in hitherto uninfected parts of the Sacramento Valley, as well as elsewhere.

Just at this time a marked revival in the wine industry took place, and the State abolished the Viticultural Commission and turned over the technical work to the College of Agriculture and the United States Experiment Station connected with it. Owing to legal difficulties, the funds appropriated for that purpose did not become available for eight months afterward, so that active work under the new arrangement has but just begun, and active measures inaugurated to insure the vineyards all aid possible in combating the phylloxera and other vine pests. The results of this work will be given to the public in advance of the regular annual report in bulletin form, as the work progresses.

FERMENTATION.

By F. T. Bioletti.

GENERAL PRINCIPLES OF FERMENTATION.

With every new vintage it becomes more clearly understood that an exact knowledge of the fundamental principles of fermentation is essential to the constant production of good wine. If we would avoid the evils of stuck tanks, lactic, mousy, acetic wines, we must know the causes and conditions favorable to these evils, and how to remedy them. Even leaving aside the unsound wines, of which I will venture to say every cellar produces more or less, it is well known that there is great difficulty in producing a uniform type of wine year after year. Though the raw material is apparently the same, the wine of one year differs in quality and character from the wine of the next. This is a serious difficulty; especially to those who desire to establish a characteristic and constant brand of wine. Any plan, therefore, which promises to overcome this uncertainty is worthy of thorough trial. Such a plan is the *use of pure yeasts or ferments*, the outcome of the study of fermentation made by recent investigators. These pure yeasts have now been used extensively for four years in France and other countries, and last year were tested in California, as shown elsewhere in this report.

Another very important improvement in the methods of wine-making is the *use of cooling machines or refrigerators.* Temperature-control, though not new in theory, has been applied with practical success to wine-making only within the last two or three years. In order to render clearer the theory and practice of these two improvements—the use of pure yeasts and temperature-control—a short account of the nature of fermentation is here given.

HISTORICAL.

The phenomenon of fermentation has been known from the earliest times, but it is only within the last fifty years that anything very definite has been known of its causes and its mode of action. The alchemists considered it a kind of purifying process, in which the alcohol already existing in the liquid threw off the impurities which disguised its presence. Leuwenock, in 1680, by the aid of a microscope, first discovered the presence of minute, roundish bodies in fermenting liquids. Becker in 1682 and Stahl in 1697, connecting these bodies with the phenomena of fermentation, formulated a theory very much resembling that afterward elaborated and sustained by Liebig. The vital theory of fermentation was first suggested by Cagniard-Latour, who, in 1835, stated it in this form: "The globules of yeast seem only to act upon a solution of sugar whilst they are alive; from this it is probably to be concluded that it is by some effect of their vegetation that they set free carbonic oxid and convert the solution into an alcoholic liquor." This theory received strong support from the works of Pasteur, where the vital theory is more definitely stated. Pasteur says: "The chemical act of fermentation is a phenomenon essentially correlative with a vital act, commencing and ceasing with the latter. I believe there is never an alcoholic fermentation without a simultaneous organization, development, and multiplication of yeast globules, or continued life of the globules already formed."

The so-called mechanical theory, which received the support of the famous German chemist, Liebig, is thus stated by him: "The elements of fermentable bodies are easily displaced and have weak affinities for each other; they are thus easily caused to form new groups. In order that this transformation should take place, it is only necessary that the elements should receive a sufficient mechanical impetus. This is given by the ferment. Ferments are not particular bodies, but any nitrogenous matter in process of decomposition." This theory, though practically abandoned at the present day, was accepted as late as 1879, with slight modification, by Naegeli, who thus briefly summarizes his views: "Fermentation is the transmission of the state of movement of the radicals and atoms of the different constituents of the living plasma to the fermentable matters; by this transmission the equilibrium of the molecules is disturbed, and thus they in their turn become decomposed." Liebig's theory denies altogether that fermentation is a vital phenomenon. Naegeli admits that a living organism is the initial cause, but seems to consider the progress of the fermentation as a purely chemical phenomenon, not depending on the vital processes of the organism. Pasteur's theory, on the contrary, is that fermentation and the vital functions of the accompanying organism are inseparably connected under the conditions where fermentation takes place.

There have been other theories of fermentation, which have all been easily shown to be false. The most notable of them are Schwieger's electrical theory and Berzelius's catalytic theory. Schwieger considered that the yeast cells formed a kind of electric battery, and broke up the sugar by a kind of electrolysis.

At the present time it is conceded by all investigators that every true fermentation is accompanied by a living organism which is in some way the cause of the phenomenon; the exact mode of action, however, is still in dispute. Regarding this mode of action, there are two main theories, that of Berthelot and that of Pasteur. Berthelot and Bernard maintain that the yeast cells excrete an amorphous substance which they call *zymase*, which is the real cause of fermentation, and acts as an enzym or soluble ferment independently of any action of the yeast plant itself. They have not, however, succeeded in separating this zymase, though an analogous substance has been separated from yeast cells, called sucrase or invertase, causing the inversion of cane sugar. O'Sullivan has lately shown that invertase is not excreted by healthy cells, and that the inversion of sugar takes place within the cell. It is therefore possible that the zymase of Berthelot exists in the cell, but cannot be separated, on account of its easily decomposable nature. According to Pasteur, fermentation (he is referring to alcoholic fermentation) may be defined as life without air. When a yeast is grown with free access of air it consumes oxygen, as do plants in general, in the exercise of its vital functions and does not require glucose. But when grown in a solution of glucose (grape sugar) out of contact with the air, in what Pasteur calls the anaërobic state, it attacks the glucose, breaks it up into several substances, and from it obtains the oxygen needed. The fermentative power of yeast, he says, is at its maximum when completely deprived of air, and decreases to zero when allowed full access to atmospheric oxygen. Fermentation, then, according to this view, is a phenomenon of nutrition, and a natural and essential part of the life economy of the plant.

Recent experiments have made it necessary to greatly modify Pasteur's views. It has been shown that, instead of the absence of oxygen being essential to the most perfect fermentation, the presence of oxygen under certain conditions actually increases the fermentative power of yeast. In fact, it seems probable that the presence of a certain amount of free oxygen is essential to the life of the yeast plant, even in its anaërobic or fermentative condition. A. J. Brown has lately shown that the fermentative action of yeast cells is not connected with their growth or reproduction, and that fermentation may continue in a liquid while the size and number of the yeast cells remain unaltered or diminished. These results support one of Liebig's views which was opposed by Pasteur, viz., that fermentation and the growth of yeast are not necessarily connected phenomena. Brown proposes the hypothesis that yeast cells can use oxygen in the manner of ordinary aërobic (air-growing) fungi, but that the exhibition of their fermentative functions is independent of their environment with regard to free oxygen, basing his hypothesis upon the same experiments which led Pasteur to an opposite conclusion, together with some new experiments made by himself.

The knowledge of the connection between micro-organisms and fermentation is thus of comparatively recent date, and the exact nature of this connection is still far from being thoroughly understood. On the other hand, the nature of the chemical changes which take place during alcoholic fermentation was investigated and very well explained by Lavoisier at the end of the last century. He showed that the sugar contained in the fermenting liquid was broken up into nearly equal parts of alcohol and carbonic acid gas. Pasteur, by improved methods, found that other substances besides alcohol and carbonic acid are produced, and gave the following proportions :

Alcohol	48.37%
Carbonic acid	46.57
Glycerine	3.22
Succinic acid	.61
Loss	1.23
Grape sugar	100.00%

The part put down as "loss" was supposed to be consumed by the yeast. This formula, though substantially correct for a pure fermentation, is subject to variation, for it has since been shown that different varieties of wine yeast will yield different proportions of alcohol. In actual practice the amount of alcohol is generally found to fall short of that indicated by Pasteur's formula. Some of the alcohol is carried off by the carbonic acid gas and by evaporation, especially in hot fermentations. If other micro-organisms besides the ordinary wine yeast are present, still more of the sugar is consumed without the production of alcohol, and other substances, such as lactic and acetic acids, are formed in the wine.

Since the investigations of Pasteur, published thirty years ago, the importance of discriminating between the fermentation caused by different yeasts has been well recognized by brewers, who have modified their methods in accordance with the facts proved by him. It is well understood by them that if a perfect fermentation is obtained the remaining part of beer-making and -keeping is comparatively simple.

This is equally true with regard to wine. There is no period in the history of a wine where its quality may be made or marred with more certainty than during the critical period of fermentation. Pasteur showed how deleterious were the effects of molds and bacteria upon the quality of a fermented liquor, and how important it was to exclude these organisms as much as possible from the murk, and to avoid the conditions favorable to their development. His studies of lactic and acetic ferments made it possible, in most cases, to avoid the injury done by these pests of fermented liquors, and aided materially in the production of sound beers and wines. He was also, perhaps, the first to suggest that even when bacteria of all kinds were absent from the fermenting liquor there were differences of quality produced, which were due to difference in the yeast itself.

It was not, however, until the investigations of C. Hansen, made some ten years ago, showed that each so-called yeast was really a mixture of numerous species, each with its own distinct characteristics, that it was possible to put brewing on an absolutely scientific basis. Previously, it was supposed that there were two kinds of brewer's yeast, top and bottom: the former a yeast which maintained itself throughout the fermenting mass and required a higher temperature, the latter a yeast which remained at the bottom and performed its functions at a lower temperature. Hansen, however, showed that each of these yeasts contained several kinds, some of which were more or less injurious to the quality of the beer. Some of them caused the beer to remain turbid; others made it bitter or gave it a disagreeable odor. Acting upon this knowledge, he devised a method for freeing the true beer yeast from all other kinds, and thus obtained a perfectly pure yeast.

When this was done, the last element of chance in beer-making was practically eliminated. From a certain kind of raw material it became possible, by means of perfect control of temperature, aëration, etc., and the exclusion of all organisms but the pure yeast, to make a perfectly definite and invariable product. This use of pure yeast in breweries has become widespread in Europe, and ten years of use have proved it an unqualified success.

On account of certain peculiarities in the conditions of wine-making, there have been greater difficulties in the application of Hansen's principles to this industry, and it is only within the last four years that it has been attempted. The impossibility of sterilizing the grapes was at first thought to be an insuperable objection to the use of pure yeast, but experience has shown that though injurious ferments cannot be entirely excluded, their action can be reduced to an inconsiderable minimum.

Marx, following the methods of Hansen, has succeeded in isolating and studying over fifty species (?) of wine ferments. These, however, are many of them doubtless only varieties of the ordinary *Saccharomyces ellipsoideus*, or wine yeast, for as great differences have been found between different selected races of the same species as between these so-called species. Rommier, in 1889, was perhaps the first to apply the facts learned about selected ferments to actual wine-making. He crushed a quantity of a certain grape, and fermented different parts of it with different cultivated varieties of *S. ellipsoideus*. Each resulting wine he found differing from the others in flavor and bouquet. Later in the year, Martinand made experiments in the same direction. He fermented a must, not like Rommier with pure cultures, but with yeasts taken from different sources. He took one from a spontaneous fermentation of cherries, one from a wine of Burgundy, one of Champagne, and several others. He found in each case that he obtained wines suggesting those from which the yeast had been obtained. After this, Rommier made some still more convincing experiments. He took an artificial must containing sugar and the necessary salts, and fermented different portions of it with yeasts taken from different wines. He then distilled the wines and obtained brandies of very distinct aromas and of different intoxicating powers, though the alcoholic strength was the same in all cases. Jacquemin has made the latest experiments in this line. Some of his first experiments were with ordinary beer wort. By the addition of tartaric acid and fermentation with the appropriate yeast, he claims to have succeeded in producing wines having distinctly the character of Bordeaux, Burgundy, Champagne, etc.

PURE AND SELECTED YEASTS.

Yeasts, as is well known, are species of fungus and consist of minute roundish cells so small that it would take 500,000,000,000 of them to fill a vessel one inch cube. These cells produce by budding, and when growing in an acid, saccharine fluid, such as beer wort or grape must, produce the phenomenon of fermentation, and are therefore often known as *ferments*. Yeast as usually seen is a cloudy, frothy liquid, which, when examined under the microscope, shows the roundish, unicellular ferments floating in the liquid, either singly or in clusters of two or three. Most of the yeasts used in the manufacture of beer, and all, until late years, of the yeasts used by wine-makers, consist not of one but of several varieties or species of ferments.

Some of these varieties are useful in varying degrees and some are harmful, and the great service which Hansen has done to the brewing industry, and indirectly to wine-making, is to have made a thorough study of these ferments and thereby settled which are harmful and which beneficial, and also to have chosen and separated out the best varieties. These varieties are now produced in large quantities and sent all over Europe, where they are known as Hansen's No. 1 and Hansen's No. 2. One is especially useful for the production of export beer and the other of beer for quick consumption.

The ferment of beer is known to botanists (for yeast is a plant) by the name of *Saccharomyces cerevisiæ*. Wine yeast resembles it closely in form, but differs notably in the quality of its products. It is known as *Saccharomyces ellipsoideus*.

The name *Saccharomyces ellipsoideus* is applied to wine yeast in general, being the name of the species. But, just as there are innumerable varieties of the species *Vitis vinifera*, or European grape, so there are dozens of varieties of wine yeast, or hundreds if we are to believe Marx and other investigators, and it is reasonable to suppose that some of these, if not harmful, are at least less useful than others.

Given the same amount of care, skill, and good luck, the quality of a wine is generally supposed to depend on two things, viz., the quality of the grape and the location of the vineyard. However, we must now add another factor—the variety and purity of the yeast. The investigations and experiments of Reitsch, Martinand, Jacquemin, and others leave no doubt of the great influence of the use of certain kinds of yeast on the quality of the resulting wine. It may be said to have been distinctly proven that by the use of pure and selected yeasts wines can be greatly improved in clearness, alcoholic strength, cleanness of taste, and in quality generally. The further claim of the most ardent advocates of pure yeasts, that by the use of appropriate kinds, any character, as for instance that of "Vin de Bordeaux," Champagne, Burgundy, etc., can be produced with a neutral grape, may be considered as yet problematic. However this may be, the use of Jacquemin's pure, selected yeasts is an assured success, for whereas in 1891 only a few wine-makers experimented with them, in 1894 thousands of wine-makers all over France used them on an industrial scale.

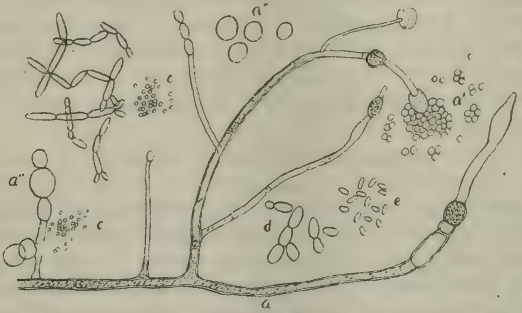

PLATE I.

a, *a′*, *a″*. Various forms of a mold, (*Mucor*).
c, *d*, *e*. Various forms of yeasts, molds, and bacteria.

Jacquemin has established a laboratory, which he calls "L'Institut La Claire," in the Jura Mountains of eastern France, at an altitude of more than 3,000 feet. Here, in an atmosphere free from germs, he selects the yeasts of all the finest vintages of France and other countries, frees them from all foreign and injurious organisms, and finally cultivates them in a perfectly pure state, and sends them in large quantities all over France and to other vine-growing countries. He supplies the special ferment of Sauterne, of Chianti, and of Johannisberg. Ferments can be obtained from him which will produce the maximum amount of alcohol from a given amount of sugar; ferments for hot countries, for cold countries; ferments for cider, for perry, for honey wine—all supposed to differ in some way and to be appropriate to different uses.

Whether all that is claimed for these yeasts is true or not, they are all certainly pure, and, as such, are of the greatest value in the production of good, sound wine.

Many French wine-makers consider that by the use of these pure yeasts they have improved their product by from 10% to 50%. This can be readily credited when we consider the ordinary process of wine-making.

When the grapes are brought to the winery the skins and, still more,

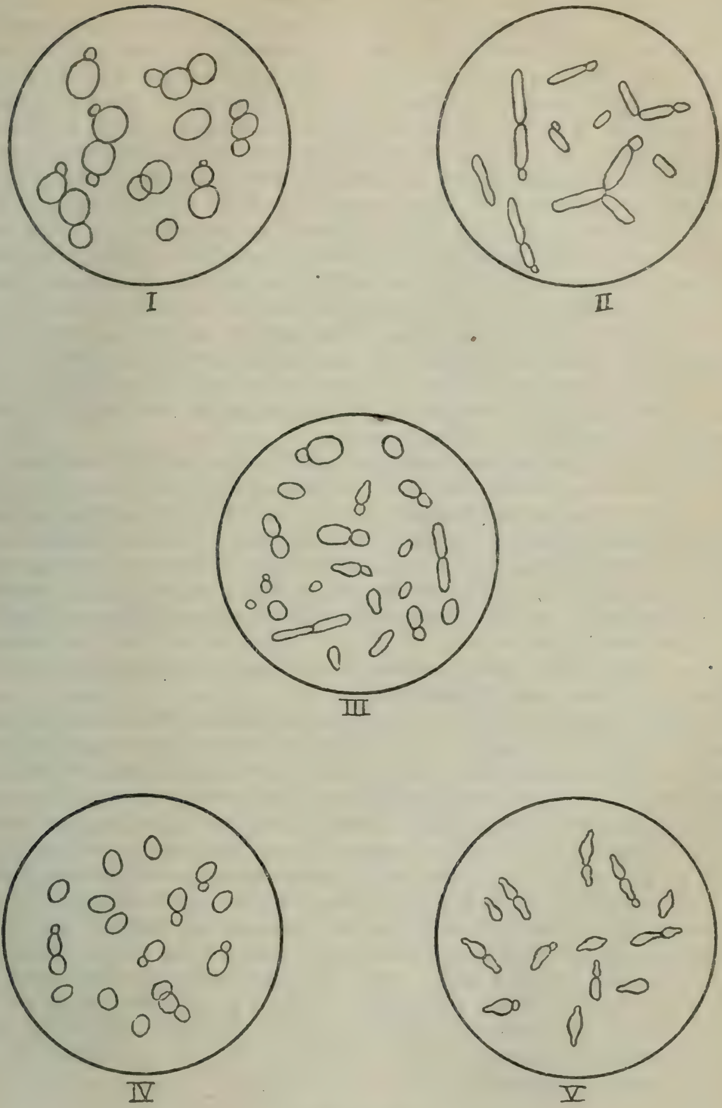

Plate II.

I. *Saccharomyces cerevisiæ* (beer yeast).
II. *Saccharomyces pastorianus* (injurious yeast).
III. Mixture of forms found in first fermentation of a California wine.
IV. *Saccharomyces ellipsoideus* (wine yeast).
V. *Saccharomyces apiculatus*.

the stems, are covered with the spores of a multitude of ferments, molds, and bacteria, all of which enter into the race for precedence—"fair field and no favor." The race is to the strong, and the strong is the organism most suited to the conditions, but not necessarily most suited to the end in view, viz., the production of a thorough alcoholic fermentation. The above figure shows some of the many forms of micro-organisms found upon the skin of a Muscat grape from Fresno. Fig. I, Plate II, shows the appearance of a pure culture of beer yeast, and Fig. II of one of the injurious yeasts found in ordinary beer fermentations. Fig. III represents an ordinary California yeast, showing the mixture of forms that almost always occur in the early stages of fermentation. The forms shown are all yeasts or molds; the bacteria do not develop in appreciable quantities till later. Fig. IV was drawn from a pure yeast from Algeria, and shows the comparative constancy of form of a pure culture, the differences of size simply indicating differences of age. All these figures are magnified about 1,000 diameters, and consequently represent the cells 1,000,000,000 times larger than they actually are. Fig. V is *Saccharomyces apiculatus*, found commonly on unripe grapes and very acid fruits, such as gooseberries and red-currants.

As a rule the first fermentation is caused principally by the *Saccharomyces apiculatus*, a small alcoholic ferment which does no great harm except that it uses up more sugar in the production of a certain amount of alcohol than does the proper wine ferment. The apiculate yeast, being paralyzed by 2% or 3% of alcohol, soon gives way to the genuine wine yeast, which, in the most favorable cases, carries on the fermentation to dryness. In the meantime, however, the molds and bacteria have been developing, and, if anything happens to check the action of the wine yeast, they take possession and give us various varieties of milk-sour, mousy, and pricked wines.

All these organisms have two well-marked forms, which may be called the active and the inactive. When in the former state they commence to operate the moment they come in contact with the must; when in the latter they do not commence active work for hours and sometimes days after being placed in the liquid. Most of the yeasts, molds, and bacteria exist on grapes in the resting-spore or inactive state, as we see by the length of time which the first crush of grapes takes in starting to ferment. Now, the practical application of the method of fermenting with pure yeasts depends on the fact that they are put into the must in fully active condition. In this way they take complete possession of the fermenting mass before the "wild yeasts" and injurious organisms have awakened from their comatose state. We thus obtain a good, clean fermentation, and avoid the production of those unpleasant odors and tastes which the undesirable organisms that are present usually communicate in a more or less marked degree.

ORIGIN OF YEAST.

Exactly what the true wine yeast (*Saccharomyces ellipsoideus*) is, or where it comes from, has not yet been determined. It seems probable, according to the latest investigations, that it is an imperfect form of some of the higher fungi, either of a mold or of one of the *pyrenomycetes*. All that we know certainly of its origin is that the spores, together with the spores of many other organisms, are found upon the outside of ripe grapes. It has been proved that the spores of the apiculate yeast (*Saccharomyces apiculatus*) pass the winter in the soil, but where or in what form the ordinary wine yeast hibernates is not known.

Among the organisms found on the surface of the grape, one of the most plentiful is the *Mycoderma vini*, or "wine flowers." This ferment develops during fermentation, together with the yeast, though its presence is not perceptible under ordinary conditions until fermentation is almost over and the yeast sinks to the bottom. The "wine flowers" then manifests itself by forming a veil on the surface of the wine.

There are various yeasts, pseudo-yeasts (*Torulæ*), and molds which consume or break up the sugar with the production of very small quantities of alcohol. The sugar thus consumed is therefore lost. The loss from this cause is generally at least 10%, and often as much as 15% or 20%; that is, a must containing enough sugar to give, according to Pasteur's formula, 13% of alcohol, will give from 10% to 12% only. This might, at first sight, be considered an advantage in the production of light, dry wines, though there is a loss of raw material. But the action of these organisms is not confined to the destruction of the sugar; besides this, their products of elimination have a deleterious effect on the quality of the wine, and less wasteful methods can be adopted for reducing the alcoholic contents.

Unripe grapes have few or no yeast spores adhering to them. The micro-organisms found on unripe grapes are principally molds; later, as the grapes ripen, the apiculate yeast (*S. apiculatus*) appears, and at complete maturity the true wine yeast (*S. ellipsoideus*) is found. The molds, apiculate yeast, and spores of bacteria occur also on the perfectly ripe fruit.

All these organisms decompose and eliminate the sugar to a greater or less extent, but the products into which the sugar is changed vary greatly for each. The apiculate yeast, for instance, produces less alcohol than wine yeast from the same amount of sugar, while the amount of alcohol yielded by the action of molds and bacteria is inconsiderable. The amounts of glycerine, succinic acid, and the quantity and kind of the various acids and ethers on which the quality of the wine so much depends, vary in an even greater degree, not only according to whether molds, bacteria, or yeast are present, but also according to the particular variety or race of yeast which predominates. It is on these facts that the method of the amelioration of wines by means of races of yeasts, originating in the famous vintages of the Medoc and Burgundy districts, depends. The spores of the true wine yeast are much less numerous, even on ripe grapes, than those of other micro-organisms. This is not due to the absence of spores of *S. ellipsoideus* in the air, but to the fact that the surface of grapes, especially when unripe, does not present the conditions favorable to the growth or existence of wine yeast.

The scarcity of yeast germs on the grapes is well illustrated by the length of time which the first vat of grapes of the vintage requires to begin its fermentation. The reason why the later vats start so much more promptly is that all the utensils, chutes, vats, etc., even after an ordinary complete cleaning, retain enough yeast cells to thoroughly leaven the whole mass of grapes.

CONDITIONS OF FERMENTATION.

Leaving out of consideration, for the moment, the addition of wine yeast, it is possible, by proper attention to conditions, to make the true wine yeast predominate over all the other micro-organisms which enter into the fermenting-vat. If the grapes are strongly acid, the bacteria will have little chance to develop, as they are best suited to a neutral or slightly acid medium. A low temperature is also unfavorable to the development of bacteria and of *Mycoderma vini* (wine-flowers). The temperature most favorable to the growth of wine yeast is between 75° and 85° F. A lower temperature is more suitable to the apiculate yeast, so that if the temperature be kept below 75° F. there is danger that the elliptical yeast will not be able to overcome it. This is especially true of musts of low sugar contents, for the antiseptic power of sugar is more effective with the apiculate than with the true elliptical wine yeast. As the former exists and enters into the vat in the proportion of 100 to 1 of the latter, it will often be three or four days, when the temperature is low, before the latter obtains the ascendency. The danger in this is a slight loss of alcohol, a lowering of the character of the wine, and a difficulty in clearing it. If the temperature is too high, on the contrary, both yeasts are killed or paralyzed, and the lactic and acetic bacteria, *Mycoderma vini*, and other injurious micro-organisms take their place. There is, then, greater danger from a too high than from a too low temperature. The trouble with "stuck tanks" and the inferior quality of the wine produced by them will illustrate this.

The objections which have been urged, very properly, against the addition of bread or beer yeast, are thus easily explained. To add a variety of yeast unsuited to the purpose in view would be bad, but to add a species adapted to the conditions of bread- or beer-making would be absolutely fatal to a wine. The yeast would certainly become diseased when subjected to conditions of nutritive medium so different from those proper to it. It would form products which would give undesirable flavors and odors to the wine, and, even if healthy, would produce a liquor resembling beer as much as wine. Moreover, as these yeasts are paralyzed by a lower percentage of alcohol than is usually found in wine, they would certainly fail to produce the effect desired, viz., to ferment out the last of the sugar.

The chemical composition of the wine, not only as regards the essential ingredients of alcohol, acid, glycerine, etc., but as regards the ethers and substances on which the bouquets of various wines depend, is influenced, not only by the race of yeast employed, but also by the composition of the grapes and the conditions of temperature and aëration under which the fermentation takes place. Part of the variation due to these influences is from direct chemical changes and decomposition, caused by heat and oxygen, but even more, especially as regards the minute quantities of volatile ethers, to the state of health of the yeast. Anything which interferes with the healthy development and growth of the yeast changes its normal products of excretion, and causes it to form substances which seriously impair the quality of the wine.

If a vat of grapes be started with yeast from an already fermenting vat, care should be taken to perform the operation at the right moment. If the yeast be taken at the beginning of the fermentation, the apiculate form will predominate; if at the end, there will be a larger amount of

Mycoderma vini and the vinegar bacterium. The yeast, then, should be taken at the height of fermentation, for at that time the *S. ellipsoideus*, or true wine yeast, predominates, and is in its most active condition.

PURIFICATION AND SELECTION OF YEASTS.

The separation of one micro-organism from others can be made in a somewhat imperfect way by preserving, for several generations, those conditions of environment most favorable to the organism it is desired to propagate. For example, if a small quantity of yeast contaminated with bacteria be put in a nutritive sugar solution which has been made highly acid with tartaric acid, the yeast will develop freely, and the bacteria with difficulty or not at all. If, now, another fermentation be started from this one in a similar solution, the relative number of bacteria will be still further decreased. If this operation be continued several times more, most kinds of bacteria will be completely eliminated, and the yeast obtained comparatively pure. Other micro-organisms may be gradually eliminated by similar series of cultures maintained at a temperature more favorable to the yeast than to the organism it is desired to get rid of. This shows the importance of constant endeavor to maintain during fermentation all the conditions of temperature, must-composition, etc., most favorable to the yeast. In this way many of the injurious ferments are destroyed or kept within innocuous limits, and fairly pure fermentations obtained.

Late experiments tend to show that fluorid of ammonium can be used successfully in the purification of yeast. The yeast is first "trained"; that is, it is cultivated through a series of musts containing gradually increasing quantities of fluorid of ammonium until it is rendered capable of existing in liquids containing an amount of the fluorid insupportable to most other micro-organisms. In this way the sugar in solutions may be made to produce as much as 2% more alcohol than when fermented in the ordinary way, on account of the absence of those ferments which consume the sugar without a corresponding production of alcohol. This method is said to have been used successfully in the fermentation of murks for distillation.

The method of purification and selection which is used at present for practical purposes is that invented by Hansen. Without describing the minutiæ of the process, it is sufficient to say that it consists essentially in the isolation of a single yeast cell. This single cell is placed in an absolutely sterile nutritive solution, where it reproduces and increases until a yeast is obtained of which every cell is a lineal descendant of the single cell first chosen. Experiments are then made with this yeast to determine its characteristics, such as its optimum temperature, the amount of alcohol it will produce, the quality of wine or beer which it will make. In this way many different yeasts are obtained, each the product of a single cell, and each having different characteristics. Those most suitable to the object in view are preserved and can be propagated indefinitely. The original or mother cell is taken, of course, preferably from the best beers or wines, in order to increase the chance of obtaining a suitable yeast.

ACIDITY.

The acidity of wine is due partially to free tartaric and malic acids, but principally to bi-tartrate of potash. In unripe grapes the quantity of free tartaric acid is very high, and gradually decreases as they ripen. When grapes pass the point of complete maturity, the decrease of acidity generally continues, so that overripe grapes often contain less than the desired amount.

The use of plaster (gypsum) to augment the acidity of musts in France was efficacious in preventing the action of bacteria in wine. Since the suppression of the use of plaster for this purpose, bacterial troubles of wine have become much more common in France. Picking the grapes before they have reached maturity, when they contain larger amounts of malic and tartaric acids, or the addition of half-ripe grapes to grapes low in acid, has been found perfectly successful as far as concerns the protection of the wine from bacteria and from "sticking," or arrest of fermentation. It cannot, however, be recommended, even for low-grade wine, for the greenness and harshness of the wine thus made is very objectionable, and the production of fine wines is absolutely impossible by this means. The addition of tartaric acid to supplement the acidity of overripe grapes has been extensively practiced of late years in southern France. When done correctly, this addition is satisfactory in many cases, though in practice it has been found very expensive and often unreliable. The difficulty of ascertaining the exact acidity of his must and the correct amount of acid to be added is seriously in the way of the use of this method by the ordinary wine-maker. A sufficiently close approximation of the sugar contents of a must is easily accomplished by means of a saccharometer or specific gravity spindle, but all the instruments in use by wine-makers for the determination of acidity are very unreliable.

The principal use of high acidity in fermentation is not aid given to the alcoholic yeast, but prevention of the growth of bacteria. As a low temperature has exactly the same effect, and as it can be controlled with more certainty with the instruments available to the ordinary wine-maker, the use of cooling devices and probably of coolers or refrigerators is much to be preferred to the addition of tartaric acid.

The addition of tartaric acid is also very much more expensive, for, to raise the acidity of the must 0.05% would cost more than the cooling, and would hardly be enough to have any perceptible effect on the fermentation, though this is the proportion usually used in southern France. To raise the must 0.2% would cost at least $8 per 1,000 gallons, which for ordinary wines would be a serious expense. The addition of so much free tartaric acid would also be likely to give a sharp and harsh acidity to the wine.

The efficacy of low temperatures for this purpose is well exemplified by many of the fermentations of Tulare grapes made at this station. Grapes containing over 24% of sugar and less than 0.3% of total acidity (expressed as tartaric acid) have fermented through thoroughly, and without the slightest sign of the action of injurious ferments or bacteria. This is due to the smallness of the vats used and the cool and even climate of Berkeley, which have kept the fermenting mass from rising to a dangerous degree of temperature.

NITROGEN.

The presence of certain soluble nitrogenous matters is indispensable to the development of yeast. These usually occur in sufficient quantity in normal grape musts, in the form of proteid substances and amids. The amids are almost completely eliminated from the must by fermentation, and only traces are found in the wine. This has suggested the use of ammonium phosphate as an aid to fermentation. Experiments by Martinand seem to show that this salt is of use in cool fermentation, giving the yeast increased vigor, and enabling it to use up all the sugar in a must which would otherwise have remained sweet for a long time at low temperatures. The addition of peptone has been tried with somewhat similar results. At high temperatures these additions seem to have no effect, or, as in the case of peptone, are harmful on account of the aid given to the development of bacteria.

AERATION.

Aëration of the must or incompletely fermented wine has been practiced extensively in various ways. Its influence on yeast in a dormant state as it exists on the surface of grapes, or in the lees of fermented wine, is very marked. If yeast in a dormant or spore state be brought into a must which has been boiled or otherwise deprived of its dissolved free oxygen, it will fail to develop. As soon as the must is aërated and thus filled with oxygen, fermentation commences. As a rule, a must is aërated sufficiently during the process of crushing, but often a "stuck fermentation" can be revived by a thorough aëration. The usual methods of doing this affect the wine in two ways: they fill the wine with oxygen, and at the same time cool it. The lowering of temperature is of great benefit, though it is not always perceptible, for the experiments of Muntz and Rosseau show that it is almost always neutralized by the heat developed by the increased fermentation consequent on the addition of oxygen. Too much aëration of the fermenting liquid should be avoided, for it changes and precipitates the color and decreases the natural aroma of the grape. There is also a loss of alcohol by evaporation, which in some cases is very noticeable. But aëration of the must before fermentation is beneficial in another way. It renders insoluble and precipitates some of the albuminoid matters of the must, thus rendering the wine less liable to the attacks of bacteria, and more apt to clear rapidly.

INFLUENCE OF TEMPERATURE.

The deleterious effect of high temperature in the fermentation of red wines was well shown in the series of experiments made by Prof. Hilgard, and published in the Viticultural Report of this station in 1886. Judging, however, by the lack of effort made to regulate temperature in the vats of wineries, the serious import of these investigations is not yet thoroughly appreciated in California. To the undue elevation of temperature which takes place in the majority of cases all over California is to be ascribed nine tenths of the trouble to which our wines are subject.

Alcoholic fermentation—that is, the transformation of grape sugar into alcohol and carbonic acid under the influence of yeast—is a phenomenon of combustion, and is accompanied by the evolution of a definite amount of heat. Berthelot has shown that 180 grams of grape sugar in being transformed into alcohol and carbonic acid produce 71,000 calories. That is to say, if a must containing 20% of sugar be fermented dry, it will give out enough heat to raise its temperature 128° F., if all the heat were retained. Of course, this result is practically impossible, and does not occur, because under all circumstances the greater part of the heat is dissipated by radiation and the escape of the carbonic acid. Enough, however, is generally retained under the conditions of wine-making in California to raise the wine to a dangerously high temperature. The temperature, therefore, of the fermenting mass is equal to that of the grapes at crushing, plus that due to the heat evolved by the fermentation, and minus that lost by the radiation and evaporation. This shows the importance of the initial temperature of fermentation.

In every fermentation of wine there is generally a loss of about 1.5% of alcohol. That is to say, the alcohol produced, instead of being 48.5% of the sugar consumed, is only 47%. If the temperature of the fermenting mass is high, this loss may reach 3%. This is due, doubtless, to a great extent, to the simple evaporation which is favored by the high temperature, but also to the presence of sugar-destroying organisms.

If the temperature of grapes when crushed is low, the fermenting-vats small, and the outside temperature not too high, the heat of combustion will not be sufficient, in general, to raise the fermenting mass to a dangerous degree. If, however, the grapes are hot when crushed, unless some cooling device be employed, the temperature of the mass will almost certainly rise to a point which is dangerous and generally fatal to the yeast. Unless the grapes are very low in sugar-contents this point is reached before the wine is dry. The death of the yeast leaves the field open to the action of various kinds of bacteria, which are not injured by these high temperatures, and which live at the expense of the sugar remaining in the "stuck" wine. This is the starting-point for most of the diseases of wine. This "stuck" wine soon becomes the prey of lactic, acetic, tartaric, and butyric fermentations caused by bacteria, which form products giving mousy, sweet-sour, milk-sour tastes, and cause the wine to become flat, turbid, and impossible to clear. Though the vitality of the yeast is not destroyed at temperatures between 90° and 100° F., and under ordinary conditions is not killed at temperatures much below 110° F., for perfect assurance of a clean fermentation and good quality the temperature should never exceed 90° F. There are two main reasons for this: In the first place, though yeast cells are not killed at 95° F., this is not their optimum temperature, as it is approximately that of many kinds of bacteria. Thus, though the yeast is not killed, and may ferment the wine dry, it is partially paralyzed and the bacteria are able to develop side by side with it and leave their products of excretion to injure the aroma, flavor, and clearing quality of the wine, besides being a constant menace to its future health. In the second place, though the yeast is not killed, it is left in a diseased condition. The quality of a wine fermented at a high temperature is injured, not only by the flavors due to the presence of bacteria, but to the abnormal products of the diseased yeast. The high temperature, though it may not be sufficient to kill the yeast, injures its vitality and changes its form, as can be well seen by a microscopic examination. Yeast thus injured excretes substances different from those excreted in its healthy and normal state, and which have a deleterious effect on the taste of the wine. According to L. Roos,* the "sweet-sour" wines so common in hot countries are the effect of this diseased condition of the yeast. The difficulty of refermenting these wines is due, according to this author, to the presence of enough of the products of the diseased yeast to render the wine sterile to healthy yeast. This condition is too common in California to need more extended description. The obvious remedy is to crush the grapes only when they are cool. In the early morning the temperature of the grapes is always lower than that of the air, even in warm seasons being generally below 65° F., and often much lower. As the sun appears, however, the average temperature of the grapes rises more rapidly than that of the air. In the middle of the day the temperature of the grapes is generally from 5° to 10° higher than that of the air. This means that when they enter the vat they will often exceed 90°. They thus start with a temperature higher than the optimum of alcoholic fermentation, and one very favorable to bacterial life. This insures a rapid increase of all the bacterial germs before the yeast germs have become active.

The rise of temperature during fermentation is, under the conditions usually existing in California, about 30° F.; that is to say, if the grapes are crushed at 60°, the temperature of the vat will rise to 90°. This is a very favorable view, for only too often, on account of the heat of the fermenting-room and the large size of the vats, the rise is much greater. If the grapes enter the vat at 70°, therefore the ordinary rise will bring them to a temperature injurious to the life of the yeast. If the initial temperature is greater than this; the corresponding rise is less, on account of the diminished activity or paralysis of the yeast and consequent cessation of the evolution of heat. The only difference will be that a grape which, if started at 70° F., would "stick" with 2% of sugar, will, if started at 80°, "stick" with 6% or 8%. If the grapes which are picked during the heat of the day are left in the boxes all night without being piled up, they will generally be cool enough in the morning. This method, however, is not always practicable on large vineyards, and even though the grapes are crushed cool, the temperature will often rise to a dangerous height if the fermenting-room is warm and the vats large. The use, then, of some cooling device seems to be the only sure and reliable method applicable to all conditions.

REFRIGERATORS, OR COOLING MACHINES.

The wine-makers of southern France and Algeria, who are confronted by the same difficulties as those which cause so much trouble and loss in California, have, after several years of trial and experience, reduced the method of cooling to a perfectly practical basis. The method is so successful and profitable that it has been adopted by a very large number of Algerian wine-makers, and seems destined to become universal there.

The use of a cooling coil placed in the vat, after the method used by brewers, has been tried, but with only partial success, on account of the hindrance to the free circulation of the wine, due to the cap of red wines. As it is in the thick cap where the highest temperature is reached, and where the most damage is caused, this method is altogether inefficient for fermentation of red wines. For white wines the method would be good but for the trouble and expense of applying it to wine in casks. Attempts have been made to utilize the cooling properties of compressed air and carbonic acid, but without success.

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* Bulletin du Ministère de l'Agriculture; Paris, 1895.

M. Toutée's metallic fermenting-vats are a step in advance. They are made of metal (on account of its value as a heat conductor), covered with some substance to protect it from the action of the acids in the wine. The vat is covered exteriorly with cloth, which is kept constantly wet. The evaporation from this cloth is the source of the cooling, and the vats are preferably exposed to the wind in order to increase the evaporation. This method gives perfect satisfaction in the fermenting of white wines, but with red wines the imperfect circulation of the wine, which rendered the use of internal coils inadequate, reduces very much its efficiency. The question of expense also makes it inapplicable to most cases, for it involves the substitution of new vats throughout the cellar. Instead of cooling the wine within the vat, attempts have been made to cool the wine outside and return it to the vat. Drawing the wine from the bottom and pumping it over on to the cap in a spray, and allowing the wine to run over a wide surface in a thin sheet exposed to a strong current of air, are some of the methods tried. The great objection to these methods is that they expose the wine too much to the air, injuring it by the evaporation of the alcohol and by liability to acetification. The cooling machines, or refrigerators, which are used extensively in Algeria now, are all made on one of two principles. One is essentially that of the water-bath, or "bain-marie." The wine is run into a receptacle, which is surrounded by a bath of cold water. It is left there until sufficiently cool, and then pumped back into the fermenting-vat. This method is too slow in operation for large cellars, though it might be useful where but little wine is made. The other principle, employing a cooling apparatus, which allows of continuous action, and is the one most successfully used, consists of a long tube, either straight or coiled, through which the wine is pumped, and which is cooled on the outside by water alone or by water and a current of air. Some modification of the ammonia coolers in use for cold storage and dairy purposes, would probably be the most efficacious that could be devised for large establishments where the requisite power is available, and where the large initial expense could be afforded.

During the vintage of 1894 in Algeria, M. Pirodon* treated over 130,000 gallons of wine with a single cooling machine. By its aid he deprived the fermenting wine of from 7 to 10 calories of heat; that is, on the average, he reduced the temperature about 15° F. The vintage lasted forty-four days, and the apparatus was used only at night, between the hours of 11 P. M. and sunrise the next morning. It consisted of twenty tubes, each 13 feet in length and nearly 2 inches in diameter, and had a capacity of a little over 500 gallons per hour. The heat lost by the wine was about equal to that gained by the water, the wine losing a little more on account of the cooling caused by the evaporation of the water on the pipes. No figures are given as to the cost of operation, but it is said to be very small.

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*See Bulletin Agricole de l'Algérie et de la Tunisie; 15 Juillet, 1895.

The practical and economic use of a cooling machine is thus demonstrated wherever a sufficient quantity of cool water is available. M. Pirodon's experience, however, shows more than this. On account of scarcity of water he was obliged to content himself with 10,000 gallons of water, collected before the vintage and used for the whole operation. In order to cool the water after using, he constructed a shallow reservoir, divided into four compartments, having a total exposed surface of about 800 square feet. Three of these compartments were filled with water to the depth of 8 inches. The other was left empty to receive the warm water coming from the machine. The three compartments held about 4,000 gallons, the other 6,000 gallons being kept in a tank to replace the water lost by evaporation. The warm water cooled in from two to four hours, according to the weather. When there was a dry wind the cooling was very rapid, and the water sank to several degrees below the temperature of the air. These results were obtained in a locality where the weather is usually very hot and moist; in a drier atmosphere the results would be even more striking. A more effective means of cooling the water after using, but one requiring a more expensive installation, is the "cheminée climagène" of M. Dessolliers. The essential parts of its construction are such that the water runs over a mass of hollow bricks exposed to a strong current of air. The bricks might be replaced by fagots of vine canes or similar material.

EXPERIMENTS WITH PURE AND SELECTED YEASTS.

Experiments with pure and selected yeasts were first made at this station in 1893 with some Johannisberg yeast brought directly from Germany by Mr. A. P. Hayne. Other experiments were made at the same time with *Botrytis cinerea*, the fungus known as "noble mold" (*Edelfäule* of the Germans and *Pourriture noble* of the French). For an account of this fungus and how to distinguish it from other molds, see page 451. More extended experiments were made during the season of 1895, with yeasts imported from M. Jacquemin of the Institut La Claire. The following notes include the results of experiments made in 1893 at the Station, of those made in 1895 at the cellars of wine-makers, and of the more extended experiments made at the Station in the same year. The analyses were all made by Mr. G. E. Colby.

RHINE-WINE YEAST AND BOTRYTIS CINEREA, OR NOBLE MOLD.

Experiment I. The grape used in this experiment was:

No. 1912, *Verdal*, from Tulare. Received October 6, 1893, in fairly good condition, just a trifle bruised, but no mold. The must showed 18.8% of solid contents by spindle and 0.75% of acid. The must was divided into three equal lots and fermented as follows:

No. 1912, ordinary fermentation;

No. 1912*a*, fermented with the addition of Rhine-wine yeast imported from Germany;

No. 1912*b*, fermented with the addition of some grapes which were covered with the spores of *Botrytis cinerea*.

The temperature of the must at crushing was 69° F., and the maximum, of 81° for No. 1912 and No. 1912*b*, and of 77° F. for No. 1912*a*, was reached on the second day. The wine fermented with German yeast progressed slowly and was not dry until the eighth day. The other two fermented more quickly, and were dry on the fourth day.

At three weeks they were all nearly clear, and were racked for the second time and taken to the cellar. At four months they were all tasted, with the following result:

No. 1912 (ordinary fermentation)—Bright, clean-tasting, no bouquet and little flavor, full acid.

No. 1912*a* (with German yeast)—Bright, clean-tasting, has a slight bouquet, and is smoother and more agreeable than No. 1912.

No. 1912*b* (with *Botrytis cinerea*)—Bright, clean-tasting, no bouquet and little flavor, full but rather green acid, not differing materially from No. 1912.

At eight months the wines showed about the same relative character. At ten months the normally fermented wine was a little more advanced than the others. The lees of all were examined under the microscope, and found to be perfectly sound.

At sixteen months there was little difference between the three samples, except that No. 1912*a* and No. 1912*b* (the treated wines) showed a little more character than the *witness* sample, but No. 1912*a*, the wine made with German yeast, was a little less advanced. Three months later all the wines were bottled. At two years and nine months all three were perfectly bright and with very little and well-settled deposit. They were light, clean-tasting wines of little character, but vinous and agreeable. There was little difference in taste, but No. 1912*a* had a fair bouquet, which was lacking in the others.

This experiment indicates the value of Rhine-wine ferments in moderating the violence of fermentation and increasing the bouquet in light musts. They also show that the presence of *Botrytis cinerea* is not harmful in the fermenting-vat. It does not seem to have any beneficial effect, but at the same time does not injure the flavor of the wine, as most other molds do. This is a point worthy of notice, as many tons of grapes were rejected in Napa Valley during the vintage of 1893 on account of the presence of this mold. That even grapes which are badly attacked by this mold are not rendered unfit for wine-making is well illustrated by the following experiment:

BOTRYTIS CINEREA.

Experiment II. No. 1929. Grapes very moldy, from *Botrytis cinerea*; from St. Helena, Napa County. The grapes when received were completely invaded by the mold, and looked like a mass of decayed grapes, stems, and mold, without a single sound berry. The mold was examined, and found to be *Botrytis cinerea*. There was no disagreeable moldy smell to the grapes, as there would have been had the mold been the common *Penicillium glaucum* (common blue mold). The must was pressed out of the grapes as they were, and fermented as white wine. It showed 27.6% of solid contents by spindle and 0.98% of acid. The temperature of the must at crushing was 68° F., and the maximum, reached the third day, was 74°. The must fermented very slowly, and at two months was still a little sweet, but bright and sound. Six weeks later it was still bright, a little sweet, quite sound, sharp-tasting on account of its high acidity and dissolved carbonic gas, but quite clean-tasting and without any taste of mold. At seven months it was bright and sound, clean-tasting and with very little sweetness left, of marked aroma, and still charged with carbonic gas. Three months later it had changed little; it had the character of a wine made from concentrated must.

At sixteen months it was in good order and perfectly dry; it was not delicate, but sound, clean-tasting, fresh, and with good acid. Two months later it was bottled. In bottle it went through a slight fermentation, and when next examined at two years and four months it was a bright, sparkling wine, but with a distinct Sherry taste. As an experiment, it was slightly sweetened and fortified, and left loosely corked. Five months later it had developed into a very good Sherry of full aroma, clean taste, and marked character; its only defects being somewhat high acid and rather too much of the "rancio" taste.

The conclusion from these experiments is, that if the grapes are only slightly attacked by the Botrytis they may be allowed to enter the fermenting-vat with the sound grapes; if badly attacked, they had better be used separately, and probably will be found useful for Sherry-making. The following experiment is confirmatory of the above:

Experiment III. No. 1982, *Verdal* (*Napoleon*), from Tulare. Received October 25, 1893. The grapes were in good condition, and the must showed 19.3% of solid contents by spindle and 0.58% of acid. The must was divided into two lots: No. 1982, fermented normally, and No. 1982*a*, fermented with the addition of 1 gallon of must from No. 1929 to 11 gallons of the Verdal must. The must added was from the grapes from Napa, which were so badly affected by *Botrytis cinerea*. The two fermentations were perfectly similar, both as regards temperature and duration. There was no perceptible difference in the wines until they were about a year old, when the Botrytis-infected wine had slightly more flavor than the witness sample. At two years and nine months the wines had been in bottle for fourteen months. The untreated wine was bright, good, clean-tasting, agreeable, but neutral, and without bouquet. The wine which had received the addition of Botrytis was very similar, but was a little smoother and less fresh-tasting.

"JOHANNISBERG" YEAST.

Experiment IV. The following samples were taken for the experiment:

No. 2014, *White Vernaccia*, from Mission San José. Received October 26, 1893, in good condition. The must showed 24.8% of solid contents by spindle and 0.84% of acid.

No. 2015, *Peverella*, from Mission San José. Received October 26, 1893, in good condition. The must showed 23.1% of solid contents by spindle and 0.94% of acid.

The musts from the above two samples of grapes were blended in the ratio of 56% of White Vernaccia to 44% of Peverella. The blended must was divided into two lots—No. 2014–15, which was fermented in the ordinary way, and No. 2014–15*a*, which was fermented with the addition of "Johannisberg" yeast. There was no perceptible difference in the fermentation of the two lots; they both attained a maximum temperature of 76°, and were dry on the ninth day. The wines were treated alike, and were both of good quality, but showed no marked difference until they were bottled at nineteen months. Seven months after bottling the wines were tasted. No. 2014–15 (normal fermentation) was bright, without deposit, much improved since bottling, and showing a little bouquet. It was smooth and more mature than No. 2014–15*a*, but a little flat. No. 2014–15*a* (German ferments) was also perfectly bright and without deposit, of distinctly higher bouquet, fresher taste, and in general of a higher quality than the witness sample. The difference of character at this time was very marked. Seven months later both wines were in good order, and had made no deposit in the bottles. The wine fermented normally was a little brownish in color, a little flat and lacking in bouquet, in general much inferior to the wine fermented with "Johannisberg" ferments, which was of a light yellowish-green, fresh and clean taste, some bouquet, and very agreeable flavor.

No. 2021. *Black Ferrara*, from Tulare. Received October 27, 1893, in good condition. The must showed 22.6% of solid contents by spindle and 0.64% of acid.

No. 2023. *Almeria*, from Tulare. Received October 27, 1893, in good condition. The must showed 19.7% of solid contents by spindle and 0.54% of acid.

The above two samples were blended in the proportion of 75% of Black Ferrara to 25% of Almeria. The must was divided into two lots, No. 2021–23, which was fermented in the ordinary way, and No. 2021–23*a*, which was fermented with the addition of German ferments. Both wines were dry on the fourth day and did not pass the temperature of 77° F. Both were treated alike, and no difference was noted until they were ten months old, when the wine fermented with German yeast was smoother and showed a little bouquet, which was quite lacking in the other. At eleven months both wines were bottled. At two years and nine months the normally fermented wine was nearly bright, but had made a considerable deposit in the bottle, was flat, tasteless, and had a disagreeable odor. The wine fermented with the addition of "Johannisberg" yeast had much less deposit, was cleaner-tasting, and though neutral was an agreeable wine, with some bouquet and flavor. As a blending wine the latter would be valuable, while the former could not be used except with the very commonest wines. This experiment is very interesting as showing the possibility of giving some quality, by the use of an appropriate selected yeast, to even the most characterless of grapes.

ANALYSES OF MUSTS AND WINES—EXPERIMENTAL FERMENTATIONS WITH YEASTS AND MOLDS IN 1893.

	Date of Picking	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six Months	Body
						By Weight	By Volume		
No. 1912. Verdal, ordinary fermentation	Oct. 4, 1893	18.80	17.70	.75	.39	7.43	9.27	.53	2.6
No. 1912*a*. Verdal, with Johannisberg yeast	Oct. 4, 1893	18.80	17.70	.75	.39	7.30	9.09	.48	2.3
No. 1912*b*. Verdal, with *Botrytis cinerea*	Oct. 4, 1893	18.80	17.70	.75	.39	7.36	9.18	.56	2.3
No. 1929. Moldy grapes (Zinfandel?) from St. Helena	Oct 12, 1893	27.60	26.31	.98	----	11.85	14.50	.96	3.8
No. 1982. Verdal (Napoleon), ordinary fermentation	Oct. 18, 1893	19.30	18.46	.58	.25	7.64	9.54	.44	2.6
No. 1982*a*. Verdal (Napoleon), with *Botrytis cinerea*	Oct. 18, 1893	19.30	18.46	.58	.25	8.34	10.42	.45	2.6
No. 2014. Vernaccia } blended	Oct. 24, 1893	24.80	23.80	.84	.32	*9.70	12.09	.67	2.8
No. 2015. Peverella }	Oct. 24, 1893	23.15	21.22	.94	.23	†9.78	12.20	.71	2.4
No. 2021. Black Ferrara } blended	Oct. 26, 1893	22.60	21.63	.64	.32	----	----	----	----
No. 2023. Almeria }	Oct. 26, 1893	19.70	19.20	.54	.41	‡8.13	10.17	.44	2.5

*No. 2014–2015, ordinary fermentation. †No. 2014–2015*a*, with Johannisberg yeast. ‡No. 2021–2023*a*, with Johannisberg yeast.

FURTHER EXPERIMENTS WITH SELECTED YEASTS.

In July, 1895, the following pure and selected yeasts were received from George Jacquemin of the "Institut La Claire," Le Locle, Doubs, France: Medoc, Burgundy, Chianti, Sauterne, Johannisberg, Algerian (for high temperatures).

A quarter-liter bottle of each was received. They were put up by Jacquemin's special method, which is guaranteed to keep them in good condition for at least six months. On September 10th a number of Sternberg flasks were filled from each bottle. Some of each of these were used to innoculate small flasks of sterilized must, and the rest kept in reserve. Needless to say, all necessary precautions were taken to avoid contamination from foreign spores. The Algerian, Burgundy, and Johannisberg yeasts fermented within two days when kept at a temperature of 77° to 82° F. The rest were then aërated, and the Bordeaux started at the end of nine days. The Sauterne and Chianti yeasts failed to develop. When the small flasks (100 c.c.) were in full fermentation the contents of each were poured into a three-liter flask of sterilized must. These three-liter flasks were then sent to various wine-makers for experiment, accompanied by the following circular explaining the method of use:

Directions for Using Pure Yeast.

(For 1,000 gallons of wine.)

1. Take four boxes (200 lbs. at least) of good, sound, freshly picked grapes. The grapes should be picked while cool. Wash them thoroughly with a stream of water. Crush them into a tub and strain off the must into a small keg.

2. Mix the contents of two flasks with the must, and allow to stand for 48 hours in a warm place (between 70° and 80° F.)

3. (*a*) For white wine: Pour the contents of the keg into the fermenting-cask, or a proportionate part into each of the casks if smaller cooperage is used, and then put in the must to be fermented.

(*b*) For red wine: Pour one sixth of the contents of the keg on to the bottom of the fermenting-vat, and then put in the rest gradually as the vat is filled, being careful to distribute it as thoroughly and equally as possible, and finally give the whole a good stirring.

4. Make a parallel experiment without using the pure yeast, under as nearly as possible similar conditions, by fermenting the same amount of the same grapes in a cask or vat of the same size. Keep the wines separate for as long a time as practicable for comparison.

CAUTION! Every utensil used in the preparation of the yeast—boxes, tubs, buckets, stirrers, etc.—must be thoroughly cleaned with boiling water immediately before use.

N. B.—It is important that all these directions should be minutely followed.

EXPERIMENTS BY WINE-MAKERS.

Fourteen samples of yeast were sent out to various wine-makers, but only seven were reported on. The results so far obtained are as follows:

Experiment I. One flask of Johannisberg yeast was sent to W. S. Keyes, Howell Mountain, St. Helena, Napa County, on October 4, 1895. The report from Mr. Hume, the cellarman, was as follows: "Two puncheons were filled on October 5th with must from Johannisberg Riesling. The must showed 24% of solid contents by the saccharometer, and a temperature of 64°. To one puncheon the yeast was added, and the other was allowed to ferment spontaneously as a witness. Fermentation in the treated puncheon was very perceptible on the evening of the following day. On the sixth day it was very active, and the temperature had risen to 85°. The saccharometer showed 7%. After this the fermentation became slower, and the temperature fell. At ten days the fermentation was very slow, and the saccharometer showed 4%, the thermometer 67° F." On June 16, 1896, samples of this wine and of the witness were received at the laboratory, and analyzed, with these results:

JOHANNISBERG RIESLING.	Alcohol.		Acid as Tartaric.	Solids.	Sugar.
	By Weight.	By Volume.			
Wine with Johannisberg yeast	9.92	12.36	.55	7.00	3.88
Wine without added yeast	12.54	15.40	.41	2.30	Dry.

The wine fermented without the addition of yeast was clear, dry, slightly astringent, clean-tasting, and of very marked aroma. The wine fermented with Johannisberg yeast was equally clear, of equal or better aroma, quite clean-tasting, and smoother than the other; it was still very sweet, and smelled slightly of sulphur. Its lees showed an abundance of yeast of rounder outline than the usual California yeast. The lees of the witness showed little yeast.

Experiment II. Two flasks of Johannisberg yeast were sent to K. Dresel, Sonoma, in October, 1895. On June 20, 1896, two samples of Traminer wine were received at the station, one fermented with yeast and one without. They were analyzed, with the following results:

TRAMINER.	Alcohol by Volume.	Acid.	Body.
With yeast	13.75	.44	2.1
Without yeast	15.00	.53	2.3

The wine fermented in the usual way was cloudy, of strong, characteristic aroma, full flavor, but not quite clean-tasting, and slightly bitter. That fermented with Johannisberg yeast differed little from the other, but was slightly more bitter. The lees of both wines, examined microscopically, showed abundance of bacteria.

Experiment III. Two flasks of Johannisberg yeast were sent to Beringer Bros., St. Helena, Napa County, on September 23, 1895. On June 19, 1896, two samples of Burger were received from the above firm; one fermented with the addition of yeast, and the other without. Analysis gave these results:

BURGER.	Alcohol by Volume.	Acid as Tartaric.	Body.
With yeast	11.50	.502	2.1
Without yeast	11.60	.577	2.3

The wine fermented in the ordinary way was cloudy, with little flavor or aroma, and with sharp, unpleasant acid. That fermented with Johannisberg yeast was nearly clear, with some aroma, clean taste, and smoother acidity than the witness. The wines examined microscopically showed very few yeast cells. The sediment of the treated wine was nearly pure, but that of the witness showed a few bacteria.

In these three experiments we have apparently two failures and one success. The reason is not far to seek, and teaches an important lesson, viz., that our yeast must be carefully chosen in accordance with the suitableness of its characteristics to the object in view, and of the conditions of environment in which we place it. The Johannisberg yeast is evidently unsuited to musts with high sugar contents, as might be expected.

In Mr. Keyes's experiment the fermentation was arrested when the must contained 12.36% of alcohol by volume and 3.88% of sugar, while the witness fermented dry with 15.4% of alcohol. At the time of analysis the treated wine was still fermenting, probably in consequence of the small amount of native yeast it contained mixed with the Johannisberg. The high amount of alcohol attained by the witness shows the power of the native yeast of eliminating large quantities of sugar and resisting the antiseptic action of alcohol. It is beyond doubt much more suited to the fermentation of such heavy musts than the Johannisberg ferment, and if such musts are to be fermented, a selected native yeast would doubtless be as good or better than any other. The "stuck" wine exhibited no sign of unsoundness, thus showing a very pure fermentation. There were no bacteria present, thus proving that the trouble was simply the inability of the yeast to break up so much sugar. The use of a yeast like this would be worthy of trial in the production of wines, such as Sherries or sweet Sauternes, in which it is intended to retain a certain amount of unfermented sugar.

In the case of Mr. Dresel's wines it is doubtful if the musts had the same amount of sugar originally. They show that the addition of pure yeast did not prevent the action of bacteria, though it might have done so in a lighter must.

In the Beringer Bros.' Burger must the Johannisberg yeast was evidently at home, and the result was an unqualified success. The must was light in sugar and body, and with full acid, and the superiority of the wine fermented with Johannisberg yeast was very marked. There was seemingly not the increase in alcohol that is claimed as a consequence of the use of pure yeasts, but in the absence of an analysis of the original musts this cannot be determined with certainty.

Experiment IV. On September 30, 1895, flasks of Burgundy and of Algerian yeasts were sent to the Swiss-Italian Colony, Asti, Sonoma County, Cal. A 3,000-gallon vat of Zinfandel was fermented with each kind, and a parallel vat without addition. The must was analyzed on October 9, 1895, and the wine on May 25, 1896, with the following results:

ZINFANDEL.	MUST.		WINE.					
	Solid Contents by Spindle	Acid as Tartaric	Alcohol by Volume	Acid as Tartaric	Tannin	Body	Sugar	Color
A. Witness	------	------	13.00	.64	.328	3.20	.46	5VR 25.5
B. Burgundy yeast	23.91	.82	13.50	.56	.240	4.10	1.00	4VR 22.6
C. Algerian yeast	22.23	.84	13.50	.51	.240	5.70	2.24	4VR 25.2

A. Zinfandel, fermented in the usual way. Nearly dry, with high acid and astringency. Its aroma was not so good as that of B and C.

B. Zinfandel, fermented with Burgundy yeast. Nearly clear, with better aroma and less acid than A; very astringent and still sweet; mellower and cleaner-tasting than A.

C. Zinfandel, fermented with Algerian yeast. Nearly clear; best aroma of the three, but contains a good deal of sugar; a full, mellow wine, which would be of excellent quality if dry.

Experiment V. Two flasks of Burgundy yeast were sent to H. Lefranc, San José, on October 2, 1895. The following careful notes of the fermentation were taken by Mr. Lefranc:

"On October 8th, at 5 P.M., we took six cases (240 pounds) of Mataro and Grenache, gathered in the cool of the morning, carefully picked them over, and then turned on the hose and washed them thoroughly, removing all foreign or dry matter. Then we placed, say a case of grapes at a time in a steamed tub, and a man stepped in with clean rubber boots and tramped the juice out, placed the strained juice (9 gallons) in a steamed 10-gallon keg, and then added the contents of the two decanters of yeast, well blending the whole. We then placed the keg, with the bung inverted, on two scantlings over the top of a fermenting-vat. Temperature of the vat, 70° F.

"October 10th, at 2 P. M., the blend commenced to ferment out of the keg, so we placed the liquid in a half-barrel. Temperature of the liquid ('levure'), 72° F.

"October 10th, at 5 P. M., we crushed in each vat about two tons, or two loads of grapes, picked that afternoon. Before crushing I placed about three quarters of a gallon of the liquid over the bottom of the treated vat, and then, on the morning of October 11th, at 7 o'clock, we continued to fill both tanks with grapes picked the same morning, alternating a load in each vat. At the same time I added three fourths of a gallon of the liquid to each load of grapes that we crushed into the vat, until I had used up the liquid in that one vat. I then had the man practice a severe foulage, first in the tank without levure, and afterward in the vat with levure. I then tested the must in the two vats, and found 24% of sugar, and temperature 68° F. I immediately placed on a false head, and after securing the same I had about 100 gallons of freshly pressed press-wine pumped on top so as to cover the false head, as is my custom with all my tanks of fresh must.

"On Saturday afternoon, October 12th, the temperature of the 'non-levured' tank was 75° F., and of the 'levured,' 77° F. I would have judged from superficial appearances that the 'levured' vat was one day older, otherwise both were alike.

"On Monday, October 14th, I removed the false head of both vats and gave another foulage, and on Tuesday allowed both tanks to run separately into 1,000-gallon oak storage casks. These vats each gave about 1,100 gallons of wine, not including the pressings. Your dose was for 1,000 gallons.

"The grapes used for both tanks were good, sound grapes, in the following proportions: $\frac{1}{2}$ Carignane, $\frac{1}{3}$ Mataro, and $\frac{1}{6}$ Grenache."

On November 5, 1895, samples of the wine experimented on were received from Mr. Lefranc, and analyzed, with the following results:

BLEND.	Alcohol by Volume.	Acid as Tartaric.	Solids.	Sugar.	Color.
With yeast	13.25	.54	5.10	1.68	1VR 40.00
Without yeast	13.25	.53	2.84	------------	1VR 34.80

The wine fermented without the addition of yeast was clear and of good aroma, dry, and very astringent. That with yeast was also clear, but not quite dry, and with less aroma, but quite sound.

Samples of the same wine were received on December 16, 1895, and analyzed, as follows:

BLEND.	Alcohol by Volume.	Acid as Tartaric.	Tannin.	Solids.	Color.
With yeast	13.60	.67	.282	2.95	VR 35.7
Without yeast	14.10	.52	.266	2.70	VR 33.9

The wine with added yeast was not quite clear, and was mellower than the other. Otherwise there was little difference: they were both of good flavor, color, and body, medium acid and full astringency.

Experiment VI. Two flasks of Burgundy yeast were sent to the Fountain Grove Vineyard, Santa Rosa, Sonoma County, California, on October 7, 1895. The yeast was used to ferment a vat of Mataro, according to the directions which were sent with it. Samples of the wine were tasted on May 17, 1896. The wine to which yeast had been added was smoother, fuller, but less developed, and with less bouquet than the witness. The acidity of the treated wine was smoother and more agreeable. Samples of the treated and the untreated wine were received June 15, 1896, and analyzed, as follows:

MATARO.	Alcohol by Volume.	Acid as Tartaric.	Tannin.	Solids.
With yeast	12.36	.577	.259	2.85
Without yeast	13.09	.540	.252	3.20

Both wines were examined microscopically, and found to be normal.

These three experiments with Burgundy yeast show fairly concordant results. The effect seems generally to be to make the wine rounder and smoother, but of slower development. The Burgundy yeast, like the Johannisberg, seems inferior to the native California yeast in eliminating sugar from heavy musts.

EXPERIMENTS AT THE VITICULTURAL LABORATORY AND CELLAR.

Experiment I. On September 26, 1895, a blend was made of Mourastel 36%, Grenache 33%, and Petit Bouschet 31%. The grapes were from Tulare, and were mature and in good condition. The blended grapes were divided into three lots:

No. 2424–26. Crushed and fermented in the usual way.

No. 2424–26*a*. The grapes were dipped in sulphured water, hosed off, and then crushed after allowing them to drain a short time on a screen.

As the crushed grapes were put in the vat, three liters of Algerian yeast was added gradually.

No. 2424–26*b*. Treated in the same way as No. 2424–26*a*, except that Bordeaux yeast was employed instead of Algerian.

The wine fermented in the ordinary way reached its maximum temperature of 97.5° F. on the fourth day, and was drawn off on the fifth, while still a little sweet. That with Algerian yeast reached its maximum temperature of 97° F. on the third day, and was dry on the fourth, when it was drawn off. The observations of the fermentation of the Bordeaux vat were identical with those of the Algerian. In nine days the witness was still cloudy, while the other two were nearly clear. Ten days later the witness was still cloudy, with flat taste, little aroma, and much inferior to the other two. The wine fermented with Algerian yeast was quite clear, with good aroma and clean taste. The Bordeaux was the best of the three; it had less aroma than the Algerian, but was more delicate. The latter two wines were racked and taken to the cellar at this time. The witness was left in the fermenting-room for two weeks longer, when it was racked also and taken to the cellar, though still not quite clear. At two months the witness had improved; it was clear, though not so bright as the others nor so clean-tasting, and possessed of less aroma. There was little difference between the other two, though No. 2424–26*b* (Bordeaux) was still a little more delicate. At five and a half months the witness was not so clear as the Algerian and Bordeaux, and tasted bitter. The Algerian had improved most of all, and, though differing little from the Bordeaux, showed more aroma. Four months later the Algerian was still the best of the series; it showed excellent aroma and was smoother and more agreeable than either of the others.

Experiment II. A blend was made consisting of 35% Black Prince, 15% Mission, 20% Moretto, 10% Tinta Amarella, 10% Tinta Câo, and 10% Mourisco Preto. The blended grapes, which came from the Tulare station, were divided into two lots:

No. 2448–53. Fermented in the ordinary way.

No. 2448–53*a*. Fermented with Algerian yeast. The grapes were dipped in sulphur water and washed, as in No. 2424–26*a*.

The witness attained a maximum temperature of 84° F. on the fourth day, and was pressed and fortified on the fifth. The Algerian yeast vat attained a maximum of 88° F. on the third day, and the wine was drawn off and fortified on the fourth. At six weeks both wines were clear and differed little, except that the witness had a slight taste of mousiness. On April 1st both wines were put in the heating-chamber for three months, at a temperature of 95° F. On July 18th, when the wines were nine months old, the witness was much superior to the wine fermented with Algerian yeast. It was nearly clear, of strong Port aroma and flavor, a Port of marked character, but somewhat coarse. The treated wine had much less of the Port character.

Experiment III. Nos. 2462–64 and 2462–64*a* consisted of 40% Carignane, 40% Aramon, and 20% Tinta Valdepeñas. The former was fermented with Bordeaux yeast and the latter with Algerian. The grapes were grown at the Tulare station. Somewhat less yeast was added to the Bordeaux fermentation than to the other. It attained a maximum temperature of 89.5° F. on the fourth day, when it was drawn off nearly dry. The Algerian fermentation attained a maximum temperature of

93° F. on the third day, and was drawn off very nearly dry on the fourth. Eight days later both wines were still cloudy, but the Bordeaux least so; it also had more aroma and tasted better than the Algerian. At twenty-five days from crushing they were both quite clear, and were racked off and taken to the cellar.

A month later the wines were bright; the Algerian was less advanced, of less agreeable flavor, but more marked aroma than the Bordeaux. At five months the Bordeaux was bright, very fresh and agreeable, had developed very quickly, showed good flavor and some bouquet, clean, fresh acid, and moderate astringency. The Algerian was a very good wine, tasted fuller and rounder than the Bordeaux, but had less bouquet. They were both good, clean-tasting wines, which had developed quickly. The blend would have been better with a little more of the Tinta.

Four months later the Bordeaux was in good order; it had good bouquet and was more astringent and more developed than the Algerian. The Algerian was smoother and of rather better tint than the Bordeaux. The wines differed in character, but were about equal in quality.

Experiment IV. Nos. 2472–74 and 2472–74*a* were blends of Palomino 35%, Beba 25%, and Malmsey 40%. The grapes came from the Tulare station, and were in good condition and well matured for sweet-wine purposes. No. 2472–74 was dipped and washed in the same way as in former experiments, and fermented with Algerian yeast. The other was fermented in the ordinary way. The vat with added yeast started more promptly and only attained a maximum temperature of 83.5° F., 1° lower than that attained by the witness. On the fourth day they were both fortified. At six weeks the wine fermented with Algerian yeast was clear, clean-tasting, and just sweet enough. The witness differed little, except that it was not quite so clean-tasting. At six months they were both racked for the second time, and put in the heating-chamber, at a temperature of 95°, for three months. Three weeks after taking from the heating-chamber the witness was nearly bright, of full aroma and good flavor, but bitter and still very raw. The Algerian wine was brighter, smoother, and cleaner-tasting, and it showed only the slightest bitterness, much less than the witness. It had rather less character, but was superior in every other way.

Experiment V. Nos. 2477–84 and 2477–84*a* were blends of Gros Mansenc 14%, Mondeuse 30%, St. Macaire 13%, Refosco 15%, Affenthaler 16%, and Carignane 12%. The grapes were from Mission San José and were all in good condition and mature, with the exception of the Gros Mansenc, which was a little green. The blended grapes were divided into two lots: No. 2477–84, treated as in former experiments and fermented with Burgundy yeast, and No. 2477–84*a*, fermented in the ordinary way. The treated wine attained its maximum temperature of 92.5° F. on the second day, and was drawn off on the third while still a little sweet. It was left in the fermenting-room, and was dry the next day. The witness attained its maximum of 96° F. on the third day, and was drawn off on the fourth while still a little sweet. Ten days after crushing the treated wine was dry and nearly clear; the witness was dry but cloudy. At eighteen days they were both clear, and were racked and taken to the cellar. At six weeks the treated wine was bright, of very distinct aroma and flavor, differing considerably from the witness, which, however, tasted more advanced in its development. At five months the witness was bright and in good condition, in general a good wine. The treated wine was bright, full, and round, and with rather more aroma than the witness. Four months later both wines were very good, but the treated wine still showed more character.

Experiment VI. No. 2531, Aramon, from Mission San José. Received October 16, 1896, in good condition. The grapes were very fine and well ripened, though not very sweet. The grapes were not washed, but were fermented with the addition of Algerian yeast. The maximum temperature, reached on the third day, was 93° F., and on the next day the wine was dry and was drawn off. At eleven days the wine was not quite clear, but was of good flavor, astringency, and acid. Ten days later it was still not quite clear or quite dry, but was of good flavor. At five months it was bright, of good color and aroma, full flavor, a very agreeable wine. It had developed with remarkable quickness, and was already a drinkable wine. Four months later it was still good and had developed some bouquet. It was one of the best light red wines made from grapes from Mission San José. Its color was light but sufficient, and of good tint. It had a good, agreeable acid, full astringency, and clean after-taste.

Analyses of Wines Made in Experimental Fermentations with Pure Yeasts.

VARIETIES USED.		Date of Picking	MUST.			
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash
Experiment I.						
No. 2424. Mourastel, from Tulare	Blended.	Sept. 24, 1895	22.10	20.60	.85	.30
No. 2425. Grenache, from Tulare		Sept. 24, 1895	24.45	23.13	.50	.25
No. 2426. Petit Bouschet, from Tulare		Sept. 24, 1895	22.50	20.99	.68	.27
Experiment II.						
No. 2448. Black Prince, from Tulare	Blended.	Sept. 28, 1895	24.10	23.42	.38	.47
No. 2449. Mission, from Tulare		Sept. 28, 1895	24.50	23.42	.53	.44
No. 2450. Moretto, from Tulare		Sept. 28, 1895	23.10	22.23	.83	.40
No. 2451. Tinta Amarella, from Tulare		Sept. 28, 1895	23.90	22.31	.58	.47
No. 2452. Tinta Câo, from Tulare		Sept. 28, 1895	23.70	21.80	.51	.45
No. 2453. Mourisco Preto, from Tulare		Sept. 28, 1885	23.70	22.23	.50	.44
Experiment III.						
No. 2462. Carignane, from Tulare	Blended.	Oct. 1, 1895	21.90	21.07	.64	.40
No. 2463. Aramon, from Tulare		Oct. 1, 1895	18.60	17.70	.75	.40
No. 2464. Tinta Valdepeñas, from Tulare		Oct. 1, 1895	27.15	26.00	.38	.43
Experiment IV.						
No. 2472. Palomino, from Tulare	Blended.	Oct. 6, 1895	23.30	22.23	.35	.43
No. 2473. Malmsey, from Tulare		Oct. 6, 1895	22.60	21.38	.38	.47
No. 2474. Beba, from Tulare		Oct. 6, 1895	24.10	23.13	.33	.41
Experiment V.						
No. 2477. Carignane, from Mission San José	Blended.	Oct. 8, 1895	25.60	24.64	.90	.29
No. 2480. Affenthaler, from Mission San José		Oct. 8, 1895	23.70	22.95	.75	.30
No. 2481. Refosco, from Mission San José		Oct. 8, 1895	25.65	24.64	.55	.31
No. 2482. St. Macaire, from Mission San José		Oct. 8, 1895	25.90	24.64	.81	.27
No. 2483. Gros Mansenc, from Mis'n San José		Oct. 8, 1895	22.40	20.83	1.26	.34
No. 2484. Mondeuse, from Mission San José		Oct. 8, 1895	23.70	22.23	.65	.26
No. 2477–84. Blend		----------	21.70	-----	.75	-----
No. 2477–84*a*. Blend		----------	23.70†	-----	.81	-----
Experiment VI.						
No. 2531.* Aramon, from Mission San José		Oct. 14, 1895	22.40	20.54	.64	.32

* Fortified. † Diluted after analysis, see record.

ANALYSES OF WINES MADE IN EXPERIMENTAL FERMENTATIONS WITH PURE YEASTS—Continued.

Blends.	FERMENT USED.	WINE.					
		Alcohol.		Tannin	Total Acid as Tartaric.		Body
		By Weight	By Volume		At Pressing	At Five Months	
	Experiment I.						
No. 2424–26	Ordinary fermentation	8.82	11.00	.175	.59	.49	2.60
No. 2424–26*a*	Algerian yeast	8.82	11.00	.174	.65	.49	2.90
No. 2424–26*b*	Bordeaux yeast	8.82	11.00	.178	.58	.48	2.60
	Experiment II.						
*No. 2448–53	Ordinary fermentation	------	17.60	.126	.48	.60	2.95
*No. 2448–53*a*	Algerian yeast	------	17.00	.116	.56	.46	3.10
	Experiment III.						
No. 2462–64	Bordeaux yeast	8.45	10.50	.186	.63	.59	3.10
No. 2462–64*a*	Algerian yeast	8.53	10.60	.166	.60	.61	3.30
	Experiment IV.						
*No. 2472–74	Algerian yeast	------	18.50	------	------	.33	2.60
*No. 2472–74*a*	Ordinary fermentation	------	17.50	------	------	.25	2.10
	Experiment V.						
No. 2477–84	Burgundy yeast	8.70	10.80	.225	.88	.71	2.60
No. 2477–84*a*	Ordinary fermentation	8.53	10.60	.255	.75	.67	3.40
	Experiment VI.						
No. 2531	Algerian yeast	8.74	10.91	.209	.68	.65	2.80

* Fortified.

GENERAL CONCLUSIONS.

Amount of Alcohol Produced.—By looking at the table of analyses of the wines made at Berkeley, it may be seen that the amount of alcohol produced falls considerably below what might have been expected from the sugar contents of the musts. This is accounted for by the water which adhered to the grapes in dipping. The dipping and washing which the grapes underwent reduced the sugar contents just 2%. As the conditions of the experiments precluded the dipping of the grapes intended for witness tests, sufficient water was added to these to reduce them in the same proportion.

There is no indication of the production of a greater amount of alcohol by the pure ferments, such as is claimed for them by some European investigators. In fact, in the wines made at the cellars of wine-makers the reverse seems, at first glance, to be true. This, however, can be accounted for by the unsuitableness of the yeast employed, by the heavy musts, and by the high temperatures which obtain in most cellars, and does not in any way indicate a loss of alcohol or waste of raw material by the pure yeast. Owing to the difficulty of obtaining exact data regarding the chemical composition of the must, and of perfectly controlling the conditions in large-scale experiments, it would be unwise to draw any conclusion with regard to this part of the question without a considerable number of further trials.

Temperature of Fermentation.—In the Berkeley experiments the wines which were started with yeast commenced to ferment directly, became dry more quickly than those fermented spontaneously, and in most cases did not attain so high a temperature. Apparently, these results in some ways contradict those obtained at the vineyards. But it is to be noted, as remarked before with regard to the formation of alcohol, that the conditions of experiment are somewhat different in the two cases. At Berkeley the coolness of the atmosphere and the smallness of the vats are conducive to cool fermentation. At the vineyards the conditions almost always insure hot fermentations. In looking only at the results from the large-scale experiments, it would be natural to suppose that the addition of yeast had caused a sudden and violent fermentation which had raised the temperature above the critical point, thus causing the wine to "stick." Taking into consideration, however, the experiments at Berkeley, it seems more probable that, instead of increasing the temperature, these selected yeasts fail to produce as much heat as the natural ferments; but being less at home in the heavy musts and at the high temperatures of most Californian vintages, they are more quickly paralyzed, and thus fail to make their wines as dry as those fermented in the ordinary way. This by no means condemns them as unsuitable for our uses, but shows that, except in special cases, they cannot be used without the coöperation of some cooling device and probably the reduction of the high sugar contents of the must by some suitable means.

Improvement of the Wine.—As to the improvement of the wine by the use of pure yeast, it is to be noted that in every one of the experiments at Berkeley the wines fermented with the addition of yeast were cleaner and fresher-tasting than those allowed to ferment with whatever yeasts happened to exist on the grapes. The difference was in some cases not very marked at first, especially in the earlier experiments, where the precaution of washing the grapes was not taken. The difference in these earlier wines, however, though slight at first, increased as the wines advanced in age. The difference in the wines made in 1895, on the contrary, was in most cases very marked from the beginning. The promptness with which fermentation commenced, and the short time in which it finished, prevented the development of any large number of injurious ferments, while the rapid clearing made it possible to rack the wine early and thus remove it from the influence of what injurious micro-organisms did exist in the lees before the taste was affected.

The Burger wine, made by Beringer Bros., shows how the same result may be obtained with light musts on the ordinary industrial scale. How much of this improvement is due simply to the addition of yeast, and how much to the particular kind of yeast added, it is impossible to say at present. Doubtless a large part of it is to be accounted for by the promptness of the fermentation, precluding the development of injurious ferments, though the experiments show also that there do exist marked differences between the products of the various yeasts used.

For sweet wines the ordinary yeast spontaneously developed from the grapes themselves seems better adapted than the Algerian yeast to bring out the strong characteristics of Ports and Sherries. This is doubtless equally true of the other yeasts tried, though no direct experiments were made with them for this purpose. However, in all cases the pure yeast produced the cleanest-tasting wines, though somewhat lacking in character. When the difference is slight, as in Nos. 2448–53 and 2448–53*a*, it does not make up for the lack of character, for the heavy, somewhat coarse character and rancio flavor of sweet wines disguise a slight deficiency in cleanness of taste. Where the difference is great, however, as in Nos. 2472–74 and 2472–74*a*, the undesirable tastes of the witness make the smoother and cleaner-tasting Algerian wine more desirable, in spite of its comparative lack of character.

Summary of Conclusions.—To sum up the conclusions that may fairly be drawn from the experiments made so far, the merits of the use of pure yeast are the following:

A quicker fermentation;
A more prompt clearing;
A cleaner taste, due to the overslaughing of injurious ferments;
And probably an improvement in flavor and bouquet.

It must not be forgotten, however, that these advantages can be obtained only if a yeast appropriate to the conditions is used; and the indications are that in many cases the use of a pure California yeast will be preferable to any other. This, however, is a matter for future investigation.

FERMENTATION AT HIGH TEMPERATURES AND WITH THE ADDITION OF VARIOUS SUBSTANCES.

Among the methods recommended and tried for the prevention of defective fermentations in hot climates, additions of certain substances to the must is perhaps the most common. These additions are made on one of three principles: (1) To render the must unsuitable to the growth of injurious organisms; (2) to increase the development of the yeast by making the must more favorable to its growth, and thus overslaughing the injurious ferments; and, (3) to keep the temperature of the must below the optimum for injurious ferments, by retarding the rapid development of the yeast.

In the first category are the addition of plaster, tartaric acid, unripe grapes; in the second, the addition of ammonium phosphate, peptone; in the third, the addition of sulphurous acid, sulphites, asaprol. The experiments described below were made in order to test the relative and absolute value of these various additions. The first two experiments were made to compare the effect of defective fermentation due to high temperature in dry and in fortified wines.

FERMENTATION AT HIGH TEMPERATURES.

(*a*) *Dry Wine.*—No. 858, Pinot Chardonay, from Mission San José. The grapes were in good condition, and yielded a must containing 24.24% of sugar and 0.48% of acid. In order to test the effect of the high temperature, which often exists in cellars in the hotter portions of the State, the must was put, immediately after pressing, into a room kept at a temperature of 93°. The wine fermented through, but showed the effect of bad fermentation. The wine was treated to the usual number of rackings, but deteriorated rapidly and was soon quite spoiled.

(*b*) *Sweet Wine.*—No. 1203, Verdelho, from Fresno. (See general record, page 319.) The grapes were in excellent condition, and showed 24.1% of solid contents by spindle and 0.65% of acid. They were fermented in a hot room at a temperature varying between 91° and 98° F., in order to test the effect of high outside temperature. The must at crushing showed a temperature of 69° F. It soon rose to 89° F., and remained at 88° to 89° throughout the experiment. The must fermented strongly for six days, when it gave unmistakable evidence of being "stuck." On the eighth day the wine was still very sweet and giving but slight signs of fermentation. In order to avoid too much contact with the air, it was racked into a smaller keg. On the next day fermentation had almost stopped, and 3 pro mille of *ammonium phosphate* was added. A day later the fermentation had revived, and continued for two or three days. At the end of twenty days the wine had a suspicious taste, and the lees showed abundance of bacteria. Six days later it tasted worse, and bacteria could be found all through the wine. The wine still showed 9% of solid contents. It was fortified to 14% of alcohol. Three months later it was racked for the third time, and refortified to 18.2% of alcohol. After fortifying the second time the wine showed 7.56% of solids, of which 4.60% was sugar. The wine was at first of very poor quality, and tasted of mousiness and bad acids. However, unlike No. 858 above, it gradually improved and lost nearly all of its unpleasant taste except the harsh acidity. At five years it was a fair wine.

These two experiments show that while high temperatures are injurious to both dry and sweet wines, they are absolutely fatal to the quality of the former, while the latter may recover to a certain extent, especially if they are fortified early. The fermentation of No. 1203 shows the inadequacy of full acidity to prevent the growth of bacteria in the must at high temperatures. Doubtless, however, if the acidity had been less, the injury would have been greater. It shows, also, how a wine may be completely invaded by bacteria when kept constantly warm, even though at no time during or after fermentation does the temperature go above 90° F. This is also an excellent illustration of a kind of fermentation which occurs frequently in cellars of the interior valleys. Musts with moderate and even low percentages of solid contents will stick with from 2% to 6% of unfermented sugar without ever attaining a dangerously high temperature. The cause is probably to be looked for in the kind of yeast which develops in the must, or in the deterrent effect on the yeast, of substances excreted by injurious ferments. The remedy in this case is the use of pure yeast or of yeast taken from a vat having a normal fermentation.

These experiments are supplemented by the large number of fermentations of Fresno and Tulare grapes made at this station. Though no special means were employed to keep down the temperature, the bulk of the fermentations may be considered cool, as compared with those taking place in the San Joaquin Valley. As little or no more bacterial troubles were experienced in the fermentation of Fresno and Tulare musts than with musts from cooler localities, the inference plainly is that the difference of must composition has less influence than the temperature conditions.

PLASTER AND AMMONIUM PHOSPHATE.

The difficulty of fermenting certain musts, especially those of the Zinfandel, from the interior valleys, suggested the series of experimental fermentations Nos. 1253, 1253*a*, and 1253*b*. The use of plaster, so general in Spain and the south of France, was compared with the use of ammonium phosphate, which has lately been recommended as a substitute, and with a normal fermentation. *Plaster* is supposed to act by increasing the acidity of the must and precipitating the albuminous matters, thereby favoring the growth of the vinous yeast, restricting the developing of secondary ferments, brightening the color, and causing a quicker clearing of the wine. *Ammonium phosphate* is supposed to act in a somewhat similar way and, besides, to increase the nitrogenous matters available for the nourishment of the yeast, thus causing quicker and more complete fermentation.

The grapes experimented with were Zinfandel from Fresno. They were received August 27, 1890, in good condition, and mature. The must showed 23.7% of solid contents by spindle and 0.54% of acid. The grapes were divided into three lots: No. 1253, No. 1253*a*, and No. 1253*b*. No. 1253 was fermented in the ordinary way; No. 1253*a* was fermented with the addition of 3 pro mille of calcium sulphate (plaster), and No. 1253*b* with 3 pro mille of ammonium phosphate. The temperature of the grapes at crushing was 72°. The maximum reached by No. 1253 was 77.5°, on the fourth day; the fermentation was slow, and on the seventh day the murk was drawn off while still sweet. The maximum reached by No. 1253*a* was 78°, on the fourth day; the fermentation was slow, but on the seventh day, when the murk was drawn off, it was less sweet than No. 1253. The maximum reached by No. 1253*b* was 86.5°, on the fourth day; the fermentation was quicker and more violent than either of the others, and on the fifth day, when the murk was drawn off, it was nearly dry.

No. 1253 (ordinary). One week after pressing the wine was quite dry, and in two weeks clear. In one month it was bright, and was racked. In two months it was bright, the lightest of the three in color, and rougher and less developed than No. 1253*a* and No. 1253*b*. The lees showed no bad germs except a few acetic; but two months later they showed some long filaments, and the wine was pasteurized. At eight months the wine was bright, of good flavor, with more bouquet than the others, and smoother than No. 1253*a*. At fifteen months it was in good order and preserved its superiority over No. 1253*a* and No. 1253*b*. It was quite mature, and two months later was bottled.

No. 1253*a* (plaster). One week after pressing the wine was quite dry, and in two weeks it was clear, and was racked. In two months it was bright, with more color than the control, but less than No. 1253*b*, without bouquet, and not equal to No. 1253*b* in flavor, but more developed than the control. The lees showed filaments at the same time as the control, and the wine was pasteurized at four months. It soon became bright, but at eight months it had less character than the control and had ceased to develop so quickly. At fifteen months it was bright and sound, with a little bouquet, good acid and astringency; a fair wine, but not equal in character to the control. It matured about the same time, and was bottled at seventeen months.

No. 1253*b* (ammonium phosphate). The wine was dry a few days after pressing, and in two weeks was clear, and was racked. In two months it was the best of the series; bright, of fair color, the only one with any bouquet, and of agreeable and vinous flavor. The lees were examined at the same time as the others, and some *S. pastorianus* found, but no unsound germs, except a few acetic. The wine was pasteurized at the same time as the others, in order that the conditions should be the same for all. After pasteurizing it did not improve as much as the others, but became a little flat. It was bottled at the same time.

ANALYSES OF THE WINES.

ZINFANDEL.	No. 1253. (Ordinary.)	No. 1253*a*. (Plaster.)	No. 1253*b*. (Am. Phos.)
Alcohol by volume	11.64%	11.45%	11.55%
Tannin	.199	.191	.199
Total acid as tartaric (at pressing)	.58	.59	.46
Total acid as tartaric (at six to eight months)	.45	.52	.48
Body	2.78	3.22	3.08
Ash	.31	.55	.48
Sugar	.22	.24	.22
Sulphuric acid	.032	.028	.213
Phosphoric acid	.060	.196	.966
Extract	2.52	2.61	2.74

The addition of both calcium sulphate (plaster or gypsum) and ammonium phosphate resulted in a quicker maturing of the wine. At two months there was a notable difference in maturity, cleanness of taste, and general quality in favor of the wine fermented with ammonium phosphate, and, in a less degree, of that fermented with plaster. Secondary ferments were found in the control and in the plastered wine, but not in the wine treated with ammonium phosphate. At fifteen months the position of the wines, with regard to quality, was exactly reversed—the control best and the plastered wine second—while the wine with ammonium phosphate, which when young was the best, had become flat, and was distinctly inferior to the others. With regard to color, the treated wines showed about twice as much as the untreated. All three were, however, of very poor color, both as regards intensity and tint; the difference was, on the whole, in favor of the plastered wine, which showed also somewhat higher acidity than the others.

With regard to the other constituents of the wine, the difference was inappreciable, except for an increase in the sulphuric acid, phosphoric acid, and consequently in the ash, of the treated wines. The amount of sulphuric acid in the plastered wine is double the maximum for natural wines, and corresponds to an amount of sulphate of potash sufficient to have a very appreciable effect on the human system, but is less than is found in some of the heavily plastered wines of Spain. It is probable that a smaller amount of plaster would have had an equal effect as far as improvement in the quality of the wine is concerned. The results obtained are in accordance with European experiences, and are not such as to encourage the use of either of the substances employed. Doubtless the same and better results can be obtained by the use of pure ferments, low temperature of fermentation, and, when necessary, the addition of tartaric acid.

The same conclusion is to be drawn from a series of experimental fermentations made with Carignane, from Mission San José. The following is a record of the experiment:

No. 1409, Carignane, from Mission San José. Received October 20, 1890, in fair condition, very soft and a few bunches moldy. The must showed 24.8% of solid contents by spindle and 0.95% of acid. The grapes were divided into five lots of 279 lbs. each, and treated as follows:

No. 1409 was fermented in the ordinary way, with foulage twice a day and floating top. The temperature at starting was 68°, and the maximum, reached the third day, was 100°.

No. 1409*a* was fermented in a closed vat with only three foulages during the time it remained in the vat. The initial temperature was 68°.

No. 1409*b* was fermented with the addition of 272 grams of calcium sulphate (plaster). The initial temperature was 68°, and the maximum, reached on the fourth day, was 98°.

No. 1409*c* was fermented with the addition of 272 grams of calcium phosphate. The initial temperature was 68°, and the maximum was 101.5°, reached on the fourth day.

No. 1409*d* was fermented with the addition of 272 grams of ammonium phosphate. The initial temperature was 68°, and the maximum reached was 101°, on the third day.

All were pressed on the sixth day, with the exception of No. 1409*a*, the closed fermentation. They were all a little sweet when drawn off; No. 1409*b* (plaster) was the sweetest and No. 1409*c* (phosphate) the driest, the others were about the same. No. 1409*a* (closed) was pressed on the thirteenth day. The upper part of the vat was full of gas, and the pomace smelled perfectly sound and good; when the murk was drawn off it was nearly dry.

No. 1409 (open vat). At one month the wine was clear, had an agreeable flavor and some aroma, clean taste, medium acid and astringency. It became bright, and was racked twice during the first two months, at the end of which time the lees showed lactic fermentation, and the wine was pasteurized. A month later it was bright, had good bouquet, no taste of lactic taint, and, next to No. 1409*b* (plaster), the best flavor of the series; it was, however, newer-tasting and less developed than No. 1409*b* (plaster). After this the wine deteriorated and did not keep well in glass.

No. 1409*a* (closed vat). One month after crushing the wine still contained a little sugar and was still cloudy. In three months it was bright, but still a little sweet. A month later the lees showed some lactic ferment, and the wine was pasteurized, though the taste was not affected. At five months the wine was bright, smooth, and clean-tasting; it had rather less flavor than No. 1409 (open vat), but the best bouquet of the series, and still had a trace of sweetness. At fifteen months it was in good condition, a little flat, but the best of the series. Some of the wine was bottled at seventeen months and some at twenty-five. At three years both wines were tasted, and the second bottling was found in good order, smooth, and of good flavor, but with little bouquet; it had improved in the bottle. The wine first bottled had not kept well.

No. 1409*b* (plaster). At one month the wine was clear, clean-tasting, with pleasant flavor, medium acid and astringency, and a little bouquet. At three months it was bright and still retained a little sweetness. The lees remained sound, and the wine was not pasteurized. At five months the wine had been racked three times, and was in good order; it had a slight bitter taste and the bouquet was not equal to that of the witness or the close-fermented wine (No. 1409 and No. 1409*a*), but the flavor was full and pleasing. After this the wine deteriorated, though the lees showed no bad ferments. It was bottled, part at seventeen and the rest at twenty-three months, but did not keep well in bottle.

No. 1409*c* (calcium phosphate). At one month the wine was clear, well flavored, and clean-tasting, but not quite equal to the open-vat sample. At three months it was bright, but not quite clean-tasting. A month later the lees showed lactic ferments, which had become perceptible to the taste, and the wine was pasteurized. At five months it was bright, but inferior to the first three of the series in flavor and bouquet, but superior to No. 1409*d* (ammonium phosphate). After this it deteriorated, but remained better than the latter.

No. 1409*d* (ammonium phosphate). The wine was bright one month after pressing, but was inferior to all the others of the series in flavor and aroma. At three months it had developed a little bouquet, but it was flat and its flavor was not very good. At four months the lees showed acetic and lactic ferments, and the wine was pasteurized. At five months it was clear, but not bright; no taste of lactic taint, but flat and the poorest in quality of the series. The wine did not improve and did not keep well in bottle.

ANALYSES OF THE WINES.

CARIGNANE.	No. 1409. (Open Vat.)	No. 1409*a*. (Closed Vat.)	No. 1409*b*. (Plaster.)	No. 1409*c*. (Calcium Phosphate.)	No. 1409*d*. (Ammonium Phosphate.)
Alcohol by volume	12.64%	13.09%	12.91%	12.18%	12.36%
Tannin	.213	.199	.213	.180	.217
Acid at pressing	.65	----------	----------	----------	----------
Acid at six months	.66	.54	.62	.56	.48
Body	3.08	2.82	3.94	3.22	3.82
Sugar	.32	.26	.28	.26	.22

It will be noted that the wine made in the closed vat had the largest amount of alcohol, there being no opportunity for loss by evaporation; in the plastered wine the slowing down of fermentation seems to have produced the same effect.

EXPERIMENTS WITH BARTH'S APPARATUS.

Two experimental fermentations were made with an apparatus invented and patented by Mr. Barth, of San Francisco. It consisted essentially of a frame to retain the pomace at the bottom of the fermenting-tank. It is so constructed that it can be used either in an open vat or in a large closed vat or cask entered by a manhole. Small experiments were tried at the Station, with entirely negative results. For details of the experiments, see Mataro, Nos. 1596, 1596*a*, 1611, and 1611*a*, page 114. The machine is intended for use in closed fermentations, the pomace being retained at the bottom to prevent the superheating of the cap. The experiments, therefore, were hardly a fair test of the machine, as, on account of the small quantity of grapes fermented, there was little opportunity for overheating. It is a very efficient and easily manipulated machine to accomplish the object in view, viz., to keep the pomace at the bottom of the vat.

EXPERIMENTS WITH COLOR GRAPES.*

Though California wines have, as a rule, an abundance of color, there are varieties which, in some localities, are lacking in this respect. In order to remedy this defect, varieties of grapes exceptionally rich in color are sometimes planted. As the bulk of the wine comes from the grapes of less color, it is important that the grapes of more color should be used economically; that is to say, in such a way as to obtain the maximum coloring effect from them. Several experiments have been made to discover the best way of doing this.

Three samples of wine were made from Cinsaut, and Petite Sirah, from Tulare—

No. 2138. Cinsaut alone.
No. 2139. Petite Sirah alone.
No. 2139*a*. Blend of Cinsaut 53% and Petite Sirah 47%.

The following table shows the color record:

Sample.	At Pressing.	At One Month.	At Two Months.	At Three Months.
No. 2138. Cinsaut	3R+Y 10.0	----------	3R+Y 4.4	3R+Y 4.2
No. 2139. Petite Sirah	2VR 30.0	----------	----------	1R 7.1
No. 2139*a*. Blend	5VR 15.4	----------	R 8.9	R 5.7

Thus, in three months the Cinsaut lost 59% of its color, the Petite Sirah 76.3%, and the blend 63%. It is to be noted that the tint of the blend was much better than that of the Cinsaut. The color is small in amount, but the superiority of tint makes it a great improvement. There is an evident loss of color in fermenting the two grapes together, due to the taking up of color by the pomace of the Cinsaut. If the blend had been made directly after pressing, the color would have been 19.7 instead of 15.4. If, however, the wines had been kept for three months and then blended, the color would have been 5.5 instead of 5.7—a slightly greater loss than by fermenting the grapes together. These calculations are made on the supposition that there would be no actual loss of color in blending the two wines, which, judging from other experiments made, is not strictly true. To preserve the maximum amount of color, then, in this instance, it would have been best to have fermented each grape separately and blended the wines immediately after pressing.

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* *Notation of Color Measurements.*—A detailed description of the method used at this laboratory to measure the color of red wine, and a full explanation of the scale, may be found on page 25 of the Viticultural Report, published in 1892. The letters used show the tint or shade of the wine, and run from violet-red to 3d red, according to the following scale:

Violet-Red.

1st violet-red.
2d violet-red.
3d violet-red.
4th violet-red.
5th violet-red.

Red.

1st red.
2d red.
3d red.

The brightest and most desirable tints are those near the top of the scale. They are the tints of the best color grapes and of new wines. As the wines become older the color changes under the influence of oxygen, and gradually drops down the scale, becoming finally yellowish or tawny. If the change continues after reaching the 3d red, the color is specified by adding letter Y to the other letters. This means that the color of the wine has become yellower than any of the tints of the scale, and that to obtain a perfect correspondence between the color of the wine and that of the scale it is necessary to look at the latter through a certain standard disk of yellow glass. Thus, when the color passes the 3d red it corresponds to the violet-red as seen through the yellow disk, and is indicated thus: VR+Y. This color then corresponds to what might have been called 4th red. The use of the yellow disk enables us to double the range of the scale, or to triple it by the use of two disks, though this is rarely necessary. Any wine whose color passes below the 3d red into the orange-reds may be considered defective, except in the case of sweet and fortified wines, which always show a yellowish tint.

The numbers after the letters indicate the intensity or amount of color possessed by a wine. No standard has been fixed as to the amount of color which a wine should possess. Any dry red wine, however, which drops below 10 may be considered deficient in amount of color, while any which retains over 25 at six months will bear dilution with lighter-colored wines.

An experiment made with Petit Bouschet and Clairette blanche gave results in some respects confirmatory of the above, in others apparently contradictory. The following were the samples made:

No. 2225. One third Petit Bouschet and two thirds Clairette blanche.
No. 2226. Petit Bouschet alone.

The blend was made before fermentation, and the color record is as follows:

Sample.	At Pressing.		At One Month.		At Two Months.		At Three Months.	
No. 2225. Blend	4VR	28.8	5VR	14.5	5VR	16.5	1R	7.3
No. 2226. Petit Bouschet	2VR	105.0	1VR	75.5	1VR	64.5	1VR	42.5

In this case the Petit Bouschet lost less (59.5%) of its color than did the blend (74.7%). This is doubtless due to the effect of the chemical composition of the Clairette blanche, rendering its wine less retentive of color than that of the Petit Bouschet. As in the former experiment, there is a loss of color in the blend, due probably to the taking up of color by the white pomace.

Apparently there should have been 35 of color in the blend; that is, one third of the amount in the Petit Bouschet alone, instead of 28.8. There is also a degradation of tint, slight at first, but very marked at three months.

There would doubtless have been some of this loss of intensity and degradation of tint even if the wines had been blended after pressing, for it seems to occur whenever wines of different intensities of color are blended, especially when one is a white wine. This is exemplified by the following series of experiments with wine made from Rupestris grapes.

No. 1907, Rupestris, from R. Hill, Glen Ellen, Sonoma County. The grapes were received in good condition on October 5, 1893. The bunches were cylindrical, well filled, and from two to three inches long; the berries spherical, from three to five lines (line=$\frac{1}{12}$ inch) in diameter, very ripe, and commencing to shrivel. The must showed 27.2% of solid contents by spindle and 0.64% of acid. Twenty-four pounds were crushed and fermented. The temperature of the must at starting was 67° F., and the maximum, reached on the third day, was 80° F. On the fourth day the wine was dry, and was drawn off. The color of the wine was extraordinary, far exceeding anything ever shown by European grapes. The color of the must before fermentation was 3R—83.3, which is higher than the average for red wines after fermentation. After fermentation the wine showed VR—444.4, a color so intense as to appear quite black before dilution. This amount of color is sufficient to allow of the addition of from 2,000% to 3,000% of white wine and still have a wine of good and sufficient color, providing there were no loss in blending. That there is a very considerable loss, however, is shown by the following experimental blends:

A. Rupestris undiluted.

B. Rupestris blended with Cinsaut of 1892 from Tulare. The color of the Cinsaut was so low as to be unreadable on the scale. It had 10.9% of alcohol by volume and 0.47% of acid.

C. Rupestris blended with Burger of 1892 from Tulare. The Burger had 9.73% of alcohol by volume and 0.51% of acid.

D. Rupestris blended with Carignane of 1893 from Tulare. The color of the Carignane was VR+1Y—4.2, its alcohol 9.9% by volume, and acid 0.53%.

E. Rupestris blended with Kleinberger of 1893 from Paso Robles. The Kleinberger had 9.0% of alcohol by volume and 0.6% of acid.

All these blends were made with 8% of Rupestris and 92% of the other variety.

TABLE OF COLOR READINGS.

Sample.	At Blending.	Loss.	At Two Weeks..	Loss.	At Two Months	Loss.
A	VR 444.0	----------	VR 210	52.7%	4VR 143	67.8%
B	5VR 17.5	50.7%	3VR+1Y 13.8	21.2	----------	----------
C	2VR 22.9	35.5	4VR 14.3	37.5	1R 9.9	56.7
D	3VR 28.0	28.9	4VR 20.7	26.1	R 12.5	55.4
E	VR 30.3	14.7	4VR 18.7	38.3	3R 14.2	53.9

In the first column headed "loss" is given the proportion of color lost in blending: that is, how much color the blends lacked of 35.5 for B, C, and E, and of 39.4 for D, which they would have had if there had been no loss. The other two columns headed "loss" show the proportions lost after blending.

The loss after blending is fairly equal for all the blends, and is uniformly less than that of the unmixed Rupestris. The losses at blending, however, show great variation and indicate the great effect which the character of the white or light-colored wine used has on the color of the blend. The loss is greater when the blend is made with a one-year-old wine than when made with a new wine, as may be seen by comparing B and C with D and E. The last sample, E, shows a much smaller loss for the Paso Robles wine than for the three Tulare wines. There is the greatest loss with a one-year-old wine from Tulare, and the least with a new wine from Paso Robles. The effect of variety may be seen by comparing B with C. Here the Cinsaut, which is notoriously poor at keeping its color, has lost much more than the Burger of the same age and locality. It is to be noted, also, that the loss in blending is, roughly speaking, proportionate to the alcoholic strength and inversely proportionate to the acidity of the wine used.

We see, then, by these experiments, that the most effective way of utilizing the color of coloring grapes is to ferment them separately, and to make the blend immediately after pressing. If the grapes are fermented together, the pomace takes up too much of the color. If the blending is deferred any length of time after pressing there is a loss in another way, for, other things being equal, the deeper the color of a wine the more it loses in a given time. We also see that we cannot tell *a priori* how much of a certain wine must be added to another to produce a desired tint or depth of color. This can only be done experimentally, for the amount of color lost in blending varies according to the age and character of the wines blended.

ASAPROL.

Asaprol has been recommended as a means of preventing the attainment of too high temperatures during fermentation. It is a light, brown-pink powder, said to be innocuous, and, as its name indicates, tasteless. No data have been found as to its chemical composition, but probably, like many commercial products, it has no definite composition formula. All that seems to be known about it is that it is one of the coal-tar products, and is supposed to act in minute doses as a mild antiseptic, reducing the vigor of the yeast without permanently injuring it or preventing it from thoroughly eliminating the sugar. Thus, it is said, it causes the fermentation to be longer and less violent, but finally more complete. Its use is based on the same principle as that of sulphurous acid, and is intended to temporarily restrain the rapid multiplication of the yeast in the same way as do the sulphur fumes when sulphur is burned in a cask before putting in the must.

A series of experiments was undertaken with the object of ascertaining the truth of these claims. The first experiments were made with concentrated must containing the skins. As the must was four years old it probably contained little living yeast. It was diluted to 20.2% of solid contents, and strained from the skins. Three fermentations were made, as follows:

A. 1,500 c.c. Must with ½ gr. of asaprol.
B. 1,500 c.c. Must with ¼ gr. of asaprol.
C. 1,500 c.c. Must without addition.

The temperature of the must was 62° F., and there was no sign of fermentation in any of the vessels at the end of forty-eight hours. All were then warmed to 85° F. The next day the wine to which no addition had been made was giving off bubbles. The lees of all showed an abundance of micro-organisms, like yeast in appearance, but which were probably *Mycoderma vini*, for the next day they were all covered with a scum of wine-flowers, the treated wines thickly, the untreated less plentifully. The wine-flowers increased rapidly on the treated wines, and it was not until the sixth day that they gave off any gas. The scum soon disappeared from the wine without asaprol, and the fermentation became rapid, ceasing when the wine was dry, on the fourteenth day. The fermentation was very slow in the wines containing asaprol, and on the fourteenth day they were still sweet and covered with a remarkably thick scum of wine-flowers. These experiments showed that a dose of 0.017% of asaprol had a marked deterrent effect on alcoholic fermentation, but was apparently favorable to the development of wine-flowers. A parallel set of experiments was made, differing from the above only in having the must with 25.5% of solid contents. There was an abundant development of wine-flowers in all, but no fermentation, showing that there was no yeast present, or that the yeast was too much debilitated to ferment in so strong a must.

For another experiment the must was diluted to 24.0% of solid contents and 0.60% of acid. To 1,500 c.c. of must 1 gram of asaprol was added. This, together with a control fermentation of the same size without addition, was kept in a warm chamber, at 80° to 82° F. Both fermented and showed an abundance of wine-flowers, but neither went through. At this temperature the asaprol had apparently no effect. The same must, with 1% of asaprol, did not ferment at all.

In order to obtain results under more nearly normal conditions, another series of experiments was made later with fresh grape-juice. The must had 23.0% of solid contents by spindle, and was divided into the following lots: A, to which was added 0.5% of asaprol; B, 0.1%; C, 0.05%; D, 0.01%, and E, to which no addition was made.

The fermentations were carried on in bottles containing each 100 gr. of must, kept in a room at 66° to 68° F. The bottles of must were sterilized, and when cool 3 c.c. of fermenting must and the indicated amount of asaprol were added to each. The must containing 0.5% of asaprol fermented very slowly, and at fifteen days contained 2.8% of alcohol and 15.6% of solid contents by spindle. It tasted perfectly dry, showing that, though there had been little fermentation, the sugar had undergone some chemical change.

At fifteen days the three wines containing the smallest amounts of asaprol were cloudy, while that containing the largest amount and the witness containing none were nearly clear. The musts containing 0.1% and 0.05% fermented more slowly and regularly than the witness. The witness and the must containing 0.01% fermented more violently during the first few days, but at fifteen days had not eliminated any more sugar than the others, with the exception of the one containing 0.5% of asaprol. When all visible signs of fermentation were over, the wine containing the heaviest dose of asaprol tasted quite dry, and all the others slightly and about equally sweet. The following table of analyses, made by Mr. G. E. Colby, shows the alcoholic and solid contents of each sample at fifteen days and at the end of all sensible fermentation:

Description of Experiments.	Alcohol at Fifteen Days.	Solid Contents by Spindle at Fifteen Days.	Solid Contents by Spindle at End of Fermentation.
A, containing 0.50% of asaprol	2.8%	15.6%	11.4%
B, containing 0.10% of asaprol	9.4	7.3	4.3
C, containing 0.05% of asaprol	9.9	7.1	3.7
D, containing 0.01% of asaprol	9.9	6.8	4.4
E, containing no addition	9.1	7.3	4.0

These experiments show that asaprol used in the ratio of about 5 to 10,000 of must has a slackening and regulating effect on the fermentation without preventing the final and complete conversion of the sugar into alcohol. The latter is a fair conclusion, for, though none of the wines became perfectly dry, the amount of sugar in the witness was equal to that in the wine containing the above quantity of asaprol. In the ratio of 1 to 10,000 it has little or no effect, unless the yeast is in an inactive condition. In doses of 5 to 1,000 it seriously impedes alcoholic fermentation, and spoils the wine by destroying or changing the sugar without the production of alcohol.

If used in the ordinary fermenting-vats, therefore, asaprol would doubtless have the effect claimed for it, viz., by weakening and retarding the fermentation to prevent the undue heating of the wine. It has the advantage over sulphurous fumes of giving no taste to the wine. It is, however, subject to the same objections as other antiseptics. It is probably, like them, injurious to the stomach, even in small doses, and should certainly not be used until more is known of its nature in this regard.

Our experiments tend to show, also, that its action is greater upon alcoholic yeasts than upon other organisms and ferments in the must. Thus, while preventing undue heating, by hampering the development of the yeast, it allows other organisms to take possession of the wine, causing, in another way, the very trouble it is intended to prevent. It is very doubtful, then, if asaprol can be used with any more advantage than sulphur, and as the ends intended to be attained by the use of these antiseptics can be easily compassed by purely mechanical means, there remains no excuse or need for their use.

ON THE QUANTITIES OF NITROGENOUS MATTERS CONTAINED IN CALIFORNIA MUSTS AND WINES.

By George E. Colby.

Introductory Note, by E. W. Hilgard.—The nitrogenous substances contained in grapes and wine have heretofore formed the subject of a number of investigations, but the conclusions reached as to the nature of these substances, and of the part they play in respect to the various qualities and diseases of wine, have not been as definite as could be desired, largely because of the failure to continue them systematically through a number of years with wines derived from different localities. The importance of the problems involved, specially as regards the connection with the fermenting and keeping qualities, and the variety of climates and soils existing in California, seemed to render this State particularly adapted to experimental investigation of this subject; which has now continued for a sufficient length of time, and has accumulated enough data, to determine definitely some points at least in the complex question. A preliminary account of the first part of this work was prepared by Mr. L. Paparelli, formerly assistant in charge of viticulture at the University, and Mr. George E. Colby, the chemical assistant in charge of viticultural work; it was read at the Indianapolis meeting of the Society for the Promotion of Agricultural Science, in August, 1890. The conclusions then reached were largely tentative, because of the relatively small number of determinations then available; they have since been greatly extended by Mr. Colby's work, and, on the whole, the conclusions first reached have been closely verified.

Broadly stated, these may be said to be that the *absolute amounts* of nitrogen in wines stand in no direct relation either to intrinsic excellence (as has been repeatedly affirmed) or to the keeping qualities of wines; and that the significance of the nitrogenous ingredients of wines must be sought in their *kind* and not in their total amounts. It is intended to prosecute this part of the research as time and means will permit, in connection with the data already obtained.

While there can be no question of the propriety of removing as far as possible a certain portion of the nitrogenous matters prior to fermentation (usually by aëration of the must), and while there can be little question that the portion thus precipitated contains true albuminoids, it is extremely probable that a large but variable part of the remaining nitrogen is contained in the form of compounds of the "amido" class, which are not affected by the reagents used to precipitate albuminoids, but are well known to serve in building up the latter for use in plant tissues, while also forming an intermediate stage in their final breaking-down, of which urea is the last link. It will be of no little interest, theoretical as well as (probably) practical, to determine the nature of these intermediate substances and their relation to the nutrition of yeast and the various qualities of wines. But such investigations are extremely difficult and complex, requiring both ample time and copious resources to be carried to a successful issue. (E. W. H.)

The nitrogenous substances in wine, and the part they play in fermentation and diseases of wine, have heretofore been studied by many chemists. In a country like California, where viticulture takes so important a place, the study of the qualities of albuminoid matters in the musts and wines of the State becomes necessary with a view to the possible explanation of their influence on quality and of the causes of their numerous diseases; above all, of lactic fermentation, which is the most common trouble of California wines. This is the more important as most of the wines attacked by lactic fermentation are rebellious to all treatments for conservation; pasteurizing having but little beneficial effect, save as a preventive measure.

We have, therefore, begun and carried on the study of the question and its relation to the condition of the soil, season, growth of vines, temperature of fermentation, etc.—data which influence materially the chemical composition of musts and wines.

Selection has been made of the characteristic members of each type of grape grown at the various culture sub-stations of the department, and an effort has been made to represent for the red-wine varieties all the grape-growing regions of California. Doubtless, had the work been advanced further for the white-wine varieties of grapes the results would have been very similar to those here given for the red-wine varieties.

The musts examined were filtered and analyzed by the Kjeldahl method for the determination of nitrogen; the nitrogen contained in the musts and wine may be calculated as "albuminoids" by use of the usual coefficient of 6.25. Many of the musts examined had no corresponding wine, because of lack of enough grapes for the fermentation experiment.

All but about one dozen of the wines reported in the tables below were made here at the station; a description of the methods of fermentation, age, etc., will be found in the part of this report relating to wines.

Four points of view presented themselves primarily, viz.:

1. The difference in nitrogen between types and varieties;

2. The influence of different climatic and soil conditions upon the nitrogen of the musts;

3. The changes brought about by the vinification of the musts by one and the same method of treatment;

4. The differences that may result from the different methods of vinification in one and the same as well as in different musts.

It need hardly be said that to carry out such investigations for a large number of these variable and inter-connected data with all their various combinations, would form the work of several lifetimes; but it is to be hoped that in the course of research some guiding principles will be evolved that will materially abridge the labors of the analysts and convey important practical information to the wine-maker.

Table A illustrates the first three points of view. Tables B and C aid, each in its particular place, to emphasize and clearly separate the facts compiled in Table A. Table D shows the fourth point.

TABLE A.

Determination of Nitrogen (*Resp.* "Albuminoids") in Samples of Filtered Musts (Vintages of 1889, 1890, 1891, 1892, and 1893), and in Samples of Wine made from the Same Musts.

(Note.—R placed after the number indicates wines sent for examination.)

Number.	Variety and Place of Production.	Vintage.	MUST.		WINE.					
			Nitrogen Per Cent.	Albuminoids Per Cent.	Nitrogen Per Cent.	Albuminoids Per Cent.	Differences, Albuminoids in Must and Wine.		Body.	Per Cent of Nitrogen in 100 Body.
							Absolute.	Per Cent.		
	BORDEAUX TYPE.									
	Cabernet Sauvignon.									
1820	Amador station	1893	.025	.156	------	------	------	------	------	------
1347	Cupertino	1890	.082	.513	------	------	------	------	------	------
1632R	Gubserville	1885	------	------	.041	.256	------	------	3.10	1.32
1633R	Gubserville	1887	------	------	.057	.356	------	------	2.55	2.24
1640R	Gubserville	1889	------	------	.057	.356	------	------	2.60	2.19
1634R	Gubserville	1890	------	------	.037	.243	------	------	2.05	1.84
1635R	Gubserville	1890	------	------	.035	.219	------	------	3.23	1.08
1636R	Gubserville	1891	------	------	.049	.306	------	------	2.80	1.75
1113	Mission San José	1889	.097	.606	.089	.556	.046	8.2	2.78	3.20
1342	Mission San José	1890	.060	.375	.042	.262	.113	30.1	2.78	1.54
1765	Mission San José	1892	.075	.468	.038	.237	.191	49.3	2.85	1.34
1248	Fresno	1890	.036	.225	------	------	------	------	------	------
2207	Tulare	1894	.071	.444	------	------	------	------	------	------
1554	Paso Robles	1891	.076	.475	------	------	------	------	------	------
1914	Paso Robles	1893	.062	.387	.055	.343	.040	11.3	3.10	1.80
	Cabernet Franc.									
1336	Cupertino	1890	.042	.263	------	------	------	------	------	------
1522	Mission San José	1891	.088	.550	------	------	------	------	------	------
1559	Paso Robles	1891	.080	.500	------	------	------	------	------	------
	Gros Verdot.									
1331	Cupertino	1890	.041	.256	------	------	------	------	------	------
1631R	Gubserville	1891	------	------	.042	.263	------	------	3.02	1.05
1382	Mission San José	1890	.098	.613	.052	.325	.288	46.9	3.32	1.53
1250	Fresno	1890	.059	.368	------	------	------	------	------	------
1681	Tulare	1892	.138	.862	------	------	------	------	------	------
1551	Paso Robles	1891	.091	.569	------	------	------	------	------	------
	Malbeck.									
2195	Amador station	1893	.037	.231	------	------	------	------	------	------
1321	Cupertino	1890	.053	.330	------	------	------	------	------	------
1303	Mission San José	1890	.092	.577	------	------	------	------	------	------
1475	Fresno	1891	.063	.393	------	------	------	------	------	------
1797	Tulare	1893	.070	.437	.053	.331	.106	24.0	3.80	1.39
1489	Paso Robles	1891	.081	.506	------	------	------	------	------	------
1917	Paso Robles	1893	.077	.481	.047	.294	.187	38.9	3.30	1.42
	Tannat.									
1835	Amador station	1893	.014	.087	------	------	------	------	------	------
1389	Cupertino	1890	.037	.231	------	------	------	------	------	------
1302	Mission San José	1890	.125	.782	.068	.425	.357	45.7	3.50	1.94
2322	Tulare	1894	.041	.256	------	------	------	------	------	------
1560	Paso Robles	1891	.079	.493	------	------	------	------	------	------
1911	Paso Robles	1893	.060	.375	.026	.162	.213	56.7	3.30	.78
	Teinturier mâle.									
2196	Amador station	1894	.064	.400	------	------	------	------	------	------
1283	Cupertino	1890	.066	.413	.035	.219	.194	47.0	3.28	1.06
1292	Mission San José	1890	.102	.638	.058	.362	.276	43.2	2.78	2.08
1205	Fresno	1890	.063	.394	.029	.181	.213	54.1	3.20	.90
1943	Tulare	1893	.141	.881	------	------	------	------	------	------
1497	Paso Robles	1891	.092	.575	.074	.463	.112	19.5	3.05	2.42

TABLE A—Continued.

Number	Variety and Place of Production.	Vintage	MUST. Nitrogen Per Cent.	MUST. Albuminoids Per Cent	WINE. Nitrogen Per Cent.	WINE. Albuminoids Per Cent	WINE. Differences, Albuminoids in Must and Wine. Absolute	WINE. Differences, Albuminoids in Must and Wine. Per Cent	WINE. Body	WINE. Per Cent of Nitrogen in 100 Body
	Gamai Teinturier.									
1823	Amador station	1893	.016	.100						
1073	Cupertino	1889			.019	.121			3.07	.62
1276	Cupertino	1890	.047	.294	.023	.142	.152	51.9	2.58	.85
1058	Mission San José	1889			.049	.307			2.65	1.85
1294	Mission San José	1890	.080	.500	.044	.273	.227	45.4	3.08	1.10
1228	Fresno	1890	.039	.244						
2209	Tulare	1894	.089	.556						
1866	Paso Robles	1893	.082	.513	.043	.268	.245	47.7	2.95	1.45
	St. Macaire.									
2197	Amador station	1894	.041	.256						
1281	Cupertino	1890	.056	.350	.024	.150	.200	57.1	3.08	.79
1637R	Gubserville	1890			.034	.212			2.85	1.19
1638R	Gubserville	1891			.046	.287			3.00	1.53
1295	Mission San José	1890	.070	.438	.023	.142	.296	67.1	2.82	.82
1706	Mission San José	1892	.055	.344	.026	.163	.181	52.6	3.20	.80
1443	Tulare	1891	.079	.493						
1846	Tulare	1893	.076	.477	.041	.256	.221	46.3	3.30	1.24
	BURGUNDY TYPE.									
	Pinot de Pernand.									
1367	Cupertino	1890	.067	.419						
1504	Mission San José	1891	.097	.606						
1258	Mission San José	1890	.100	.625	.050	.313	.312	50.0	3.10	1.61
1799	Tulare	1893	.094	.577						
1226	Fresno	1890	.101	.631						
1480	Paso Robles	1891	.074	.472						
	Pinot St. George.									
1819	Amador station	1893	.040	.250	.019	.119	.132	52.8	3.30	.59
1332	Cupertino	1890	.110	.688						
1508	Mission San José	1891	.083	.519						
1910	Mission San José	1893	.070	.437	.033	.207	.230	52.6	2.40	1.37
1224	Fresno	1890	.083	.519						
2005	Tulare	1893	.057	.356						
1480	Paso Robles	1891	.067	.419						
	Meunier.									
1808	Amador station	1893	.042	.262						
1280	Cupertino	1890	.043	.269						
1259	Mission San José	1890	.087	.544						
1212	Fresno	1890	.060	.375						
2309	Tulare	1894	.063	.394						
1558	Paso Robles	1891	.047	.295						
	**Chauché noir.*									
1832	Amador station	1893	.030	.187						
1290	Cupertino	1890	.065	.406						
1298	Mission San José	1890	.117	.731	.056	.345	.381	52.0	2.45	2.22
1446	Tulare	1891	.165	1.031						
1620	Tulare	1892	.188	1.175	.105	.656	.519	44.1	3.00	3.50
1557	Paso Robles	1891	.070	.437						
1868	Paso Robles	1893	.079	.494	.038	.237	.257	52.0	3.10	1.22

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*The Chauché noir is classed with the Burgundies because it is used largely in the make-up of wines sent out under that name.

TABLE A—Continued.

Number	Variety and Place of Production.	Vintage	MUST. Nitrogen Per Cent	MUST. Albuminoids Per Cent	WINE. Nitrogen Per Cent.	WINE. Albuminoids Per Cent	WINE. Differences, Albuminoids in Must and Wine. Absolute	WINE. Differences, Albuminoids in Must and Wine. Per Cent.	WINE. Body	WINE. Per Cent of Nitrogen in 100 Body.
	Robin noir.									
2199	Amador station	1894	.033	.206						
1284	Cupertino	1890	.025	.156						
1428	Mission San José	1890	.056	.350						
1953	Mission San José	1893	.062	.385	.049	.306	.078	20.3	2.60	1.88
1230	Fresno	1890	.026	.162						
2336	Tulare	1894	.045	.281						
1552	Paso Robles	1891	.104	.650						
	SOUTHERN FRENCH TYPE.									
	Petite Sirah.									
1278	Cupertino	1890	.065	.406						
1296	Mission San José	1890			.052	.325			3.45	1.50
1492	Paso Robles	1891	.085	.531						
	Serine.									
2086	Amador station	1894	.051	.319						
1147	Cupertino	1889			.035	.229			3.50	1.00
1370	Cupertino	1890	.061	.381						
1341	Mission San José	1890	.088	.551	.047	.294	.257	46.9	3.32	1.40
1042	Fresno	1889			.044	.275			3.80	1.15
1242	Fresno	1890	.055	.344	.027	.168	.176	51.1	2.70	1.00
1438	Tulare	1891	.103	.643						
1814	Tulare	1893	.109	.681	.067	.419	.262	38.4	3.20	2.10
1488	Paso Robles	1891	.072	.450						
1895	Paso Robles	1893	.089	.546	.054	.337	.209	39.3	3.30	1.66
	Mondeuse.									
2174	Amador station	1894	.022	.137						
1595	Los Guilicos	1891	.041	.256	.027	.168	.088	34.1	3.35	.81
1312	Cupertino	1890	.052	.325	.016	.100	.225	69.1	2.70	.59
1151	Cupertino	1889	.080	.500	.056	.351	.149	30.0	3.05	1.85
1142	Mission San José	1889	.088	.550	.073	.456	.094	17.0	2.87	2.50
1334	Mission San José	1890	.071	.444	.028	.175	.269	60.5	2.58	1.08
1639R	Gubserville	1891			.032	.200			2.55	1.25
1888	Tulare	1893	.056	.350	.024	.150	.200	57.1	2.30	1.04
1922	Paso Robles	1893	.068	.425	.036	.225	.200	47.1	3.30	1.09
	Cinsaut.									
1825	Amador station	1893	.044	.275						
2050	Cupertino	1893	.056	.350						
1408	Mission San José	1890	.095	.596	.053	.331	.265	44.4	2.58	2.05
1477	Paso Robles	1891	.077	.481						
1434	Tulare	1891	.171	1.069	.124	.775	.284	27.4	3.80	3.26
1614	Tulare	1892	.140	.870	.093	.581	.289	33.2	2.95	3.10
	Mataro.									
1069	Amador station	1889	.045	.281	.021	.131	.151	53.3	2.70	.80
1255	Amador station	1890	.036	.225	.015	.094	.131	58.1	2.58	.58
1596	Asti, Sonoma County	1891	.037	.231	.022	.137	.094	40.8	3.35	.66
1609	Mountain View	1891	.049	.306	.019	.119	.187	61.1	2.55	.74
1610	San José	1891	.029	.179	.010	.063	.116	65.3	2.45	.41
1252	Fresno	1890	.035	.218	.011	.069	.149	69.8	2.32	.47
1921	Paso Robles	1893	.076	.475	.023	.144	.331	69.6	2.30	1.00
2313	Tulare	1894	.042	.262						

TABLE A—Continued.

Number	Variety and Place of Production.	Vintage	MUST.		WINE.					
			Nitrogen Per Cent	Albuminoids Per Cent	Nitrogen Per Cent	Albuminoids Per Cent	Differences, Albuminoids in Must and Wine.		Body	Per Cent of Nitrogen in 100 Body
							Absolute	Per Cent		
	Carignane.									
1070	Amador station	1889	.032	.200	.011	.069	.131	65.6	3.07	.36
1525	Asti, Sonoma County	1891	.026	.162	.010	.063	.099	61.9	2.78	.39
1335	Cupertino	1890	.050	.313	------	------	------	------	------	------
1409	Mission San José	1890	.100	.625	.048	.300	.325	52.0	3.08	1.55
1251	Fresno	1890	.026	.163	.007	.044	.119	72.4	2.36	.28
1447	Tulare	1891	.058	.362	------	------	------	------	------	------
1628	Tulare	1892	.065	.406	.031	.194	.212	52.2	3.30	.94
1887	Tulare	1893	.075	.469	.035	.219	.260	53.4	2.60	1.34
1576	Paso Robles	1891	.049	.306	.033	.206	.100	32.6	2.60	1.27
	Grenache.									
1822	Amador station	1893	.034	.212	------	------	------	------	------	------
1333	Cupertino	1890	.053	.331	------	------	------	------	------	------
1249	Fresno	1890	.020	.125	.015	.094	.031	24.8	3.02	.50
1444	Tulare	1891	.068	.425	------	------	------	------	------	------
1626	Tulare	1892	.060	.375	.041	.256	.119	31.7	2.90	1.40
1527	Paso Robles	1891	.070	.440	------	------	------	------	------	------
1721	Paso Robles	1892	.050	.313	.028	.175	.138	44.0	2.85	.99
	César.									
1594	Los Guilicos	1891	.072	.045	.045	.281	.169	37.5	3.35	1.34
	Petit Bouschet.									
1394	Cupertino	1890	.094	.588	------	------	------	------	------	------
1378	Mission San José	1890	.100	.625	.052	.325	.300	48.0	3.32	1.56
1245	Fresno	1890	.097	.606	------	------	------	------	------	------
1435	Tulare	1891	.060	.375	.045	.281	.094	25.1	3.12	1.40
1529	Paso Robles	1891	.091	.568	------	------	------	------	------	------
2009	Paso Robles	1893	.079	.493	.051	.319	.174	35.3	3.10	1.64
	Aramon.									
2316	Amador station	1894	.040	.250	------	------	------	------	------	------
1189	Cupertino	1889	------	------	.015	.095	------	------	3.50	.43
1414	Cupertino	1890	.060	.375	.033	.206	.169	45.1	2.82	1.18
1175	Mission San José	1889	------	------	.042	.273	------	------	2.67	1.60
1377	Mission San José	1890	.081	.506	.046	.287	.219	43.3	2.58	1.70
1246	Fresno	1890	.035	.219	.011	.069	.150	68.3	2.82	.38
1436	Tulare	1891	.055	.344	------	------	------	------	------	------
1639	Tulare	1892	.061	.381	.032	.200	.181	47.3	2.65	1.20
1755	Paso Robles	1892	.055	.344	------	------	------	------	------	------
	AUSTRIAN AND HUNGARIAN TYPE.									
	Zinfandel.									
1071	Amador station	1889	.043	.269	.028	.175	.094	34.9	3.07	.90
1257	Amador station	1890	.021	.131	.013	.081	.050	38.1	2.82	.45
1098	Fresno	1889	.061	.381	.047	.294	.087	22.9	3.50	1.34
1253	Fresno	1890	.030	.187	.015	.094	.093	49.9	2.78	.54
	Blue Portuguese.									
1365	Cupertino	1890	.061	.381	------	------	------	------	------	------
1262	Mission San José	1890	.087	.544	.042	.262	.282	51.7	2.58	1.60
1206	Fresno	1890	.057	.356	.025	.156	.200	56.1	3.08	.80
1440	Tulare	1891	.104	.650	------	------	------	------	------	------
1618	Tulare	1892	.090	.560	.067	.419	.141	25.4	3.08	2.20
1481	Paso Robles	1891	.077	.481	------	------	------	------	------	------
	Rothgipfler (White).									
1800	Amador station	1893	.065	.406	------	------	------	------	------	------
1359	Mission San José	1890	.063	.396	------	------	------	------	------	------
1530	Paso Robles	1891	.077	.481	------	------	------	------	------	------

TABLE A—Continued.

Number	Variety and Place of Production.	Vintage	MUST.		WINE.					
			Nitrogen Per Cent	Albuminoids Per Cent	Nitrogen Per Cent	Albuminoids Per Cent	Differences, Albuminoids in Musts and Wine.		Body	Per Cent of Nitrogen in 100 Body
							Absolute	Per Cent		
	Marzemino.									
1293	Cupertino	1890	.065	.406	------	------	------	------	------	------
1358	Mission San José	1890	.042	.252	------	------	------	------	------	------
1231	Fresno	1890	.014	.087	------	------	------	------	------	------
	Grüner Velteliner (White).									
1306	Cupertino	1890	.047	.293	------	------	------	------	------	------
1346	Mission San José	1890	.075	.468	.025	.156	.312	66.6	2.58	.94
1208	Fresno	1890	.041	.256	.017	.106	.150	58.6	1.80	.94
	Kadarkas.									
1307	Cupertino	1890	.071	.443	.032	.200	.243	54.8	2.58	1.24
1418	Mission San José	1890	.107	.668	.076	.475	.188	28.9	3.58	2.13
1461	Fresno	1891	.064	.400	------	------	------	------	------	------
	White Vernaccia.									
1400	Cupertino	1890	.045	.281	------	------	------	------	------	------
1422	Mission San José	1890	.072	.450	------	------	------	------	------	------
1236	Fresno	1890	.043	.268	------	------	------	------	------	------
1549	Paso Robles	1891	.079	.493	------	------	------	------	------	------
	NORTH ITALIAN TYPE.									
	Fresa.									
2175	Amador station	1894	.034	.212	------	------	------	------	------	------
1327	Cupertino	1890	.065	.406	------	------	------	------	------	------
1469	Fresno	1891	.059	.369	------	------	------	------	------	------
2318	Tulare	1894	.049	.306	------	------	------	------	------	------
1553	Paso Robles	1891	.086	.537	------	------	------	------	------	------
	Barbera.									
2276	Asti, Sonoma County	1894	.057	.356	------	------	------	------	------	------
1324	Cupertino	1890	.085	.531	------	------	------	------	------	------
1573	Mission San José	1891	.065	.406	.034	.213	.193	47.7	3.25	1.04
1445	Tulare	1891	.094	.587	------	------	------	------	------	------
1675	Tulare	1892	.075	.468	.032	.200	.268	57.3	3.20	1.00
	Nebbiolo, or Spanna.									
1857	Amador station	1893	.034	.212	------	------	------	------	------	------
2277	Asti, Sonoma County	1894	.037	.231	------	------	------	------	------	------
1401	Cupertino	1890	.056	.350	----	------	------	------	------	------
1285	Cupertino	1890	.028	.175	------	------	------	------	------	------
1554	Paso Robles	1891	.067	.419	------	------	------	------	------	------
1954	Paso Robles	1893	.085	.531	.052	.325	.206	38.8	2.85	1.83
1958	Paso Robles	1893	.074	.462	------	------	------	------	------	------
	Refosco.									
1416	Cupertino	1890	.084	.525	------	------	------	------	------	------
1584	Mission San José	1891	.112	.700	.056	.350	.350	50.0	3.45	1.62
	Crabb's Black Burgundy.									
1526	Asti, Sonoma County	1891	.042	.262	.028	.175	.087	33.3	2.95	.94
1318	Cupertino	1890	.057	.356	.030	.187	.169	47.4	2.78	1.06
1343	Mission San José	1890	.091	.569	.041	.256	.313	55.0	3.32	1.20
1219	Fresno	1890	.081	.506	------	------	------	------	------	------
1437	Tulare	1891	.081	.506	------	------	------	------	------	------
1615	Tulare	1892	.088	.550	.040	.250	.300	54.5	3.05	1.38
1496	Paso Robles	1891	.068	.425	.047	.293	.132	30.8	2.80	1.60

TABLE A—Continued.

Number	Variety and Place of Production.	Vintage	MUST.		WINE.					
			Nitrogen Per Cent.	Albuminoids Per Cent.	Nitrogen Per Cent.	Albuminoids Per Cent.	Differences, Albuminoids in Must and Wine.		Body	Per Cent of Nitrogen in 100 Body
							Absolute	Per Cent.		
	Dolcetto.									
1572	Asti, Sonoma County	1891	.049	.308	.027	.168	.140	45.4	2.60	1.30
	Barolo.									
1575	Asti, Sonoma County	1891	.064	.400	.033	.206	.194	48.5	3.20	1.03
	Bonarda.									
1384	Cupertino	1890	.055	.344	.023	.144	.200	58.1	2.58	.85
1362	Cupertino	1890	.055	.344	.035	.219	.125	36.3	2.70	1.29
1385	Cupertino	1890	.067	.418	------	------	------	------	------	------
2310	Tulare	1894	.071	.444	------	------	------	------	------	------
1869	Paso Robles	1893	.079	.493	.045	.281	.212	43.0	2.80	1.60
	Gros Mansenc.									
2198	Amador station	1893	.034	.212	------	------	------	------	------	------
1277	Cupertino	1890	.056	.350	.028	.175	.175	50.0	2.82	.98
1339	Mission San José	1890	.087	.544	.038	.237	.307	56.4	2.82	1.36
1243	Fresno	1890	.050	.313	.016	.100	.213	68.0	2.95	.54
1899	Tulare	1893	.088	.548	.049	.306	.242	44.3	3.80	1.29
1547	Paso Robles	1891	.066	.412	------	------	------	------	------	------
2083	Paso Robles	1893	.093	.582	.049	.306	.276	47.3	2.85	1.72

EXAMINATION OF THE MUSTS.

Differences between the Different Types.—In estimating the averages for each type, no regard has been paid to season or locality of growth, nor to the climatic or soil conditions of individual samples, as these may be considered as common to each type. In this table the arrangement of types is from highest to lowest in average content of nitrogen.

Burgundy, 33 samples	.072
Bordeaux, 55 samples	.070
North Italian, 34 samples	.066
Southern French, 61 samples	.064
Hungarian, 22 samples	.060

It is thus seen at a glance that the Burgundy and Bordeaux types are nearly equal in their content of nitrogen, and that while the variation in average amount of nitrogen in the musts for the several types is quite small, the Burgundy and Bordeaux types stand highest, while the Hungarian is lowest in the group.

Differences between Different Varieties.—In the five types chosen for these examinations there are embraced thirty-nine varieties of grapes, each variety being represented by samples grown under varying conditions; the averages may, therefore, be regarded as fairly comparable. They are arranged in the following table in order of highest to lowest:

AVERAGE AMOUNT OF NITROGEN IN GRAPE-VARIETIES.

Chauché noir, 7 samples	.107	Bonarda, 5 samples	.065
Refosco, 2 samples	.098	St. Macaire, 6 samples	.063
Cinsaut, 6 samples	.095	Barolo, 1 sample	.061
Pinot de Pernand, 6 samples	.088	Tannat, 6 samples	.060
Teinturier mâle, 6 samples	.088	Gamai Teinturier, 6 samples	.060
Petit Bouschet, 6 samples	.086	White Vernaccia, 4 samples	.060
Gros Verdot, 5 samples	.085	Mondeuse, 8 samples	.059
Kadarkas, 3 samples	.080	Fresa, 5 samples	.058
Blue Portuguese, 6 samples	.079	Meunier, 6 samples	.057
Petite Sirah, 2 samples	.075	Aramon, 7 samples	.055
Pinot St. George, 7 samples	.075	Spanna, 7 samples	.054
Barbera, 5 samples	.075	Grüner Velteliner, 3 samples	.054
Serine, 8 samples	.074	Carignane, 9 samples	.053
Crabb's Black Burgundy, 7 samples	.072	Robin noir, 7 samples	.051
César, 1 sample	.072	Grenache, 7 samples	.050
Cabernet Franc, 3 samples	.070	Dolcetto, 1 sample	.049
Malbeck, 7 samples	.069	Mataro, 8 samples	.043
Gros Mansenc, 7 samples	.069	Marzemino, 3 samples	.040
Rothgipfler, 3 samples	.068	Zinfandel, 4 samples	.039
Cabernet Sauvignon, 9 samples	.065		

In this table we have the two well-known varieties, Chauché noir and Zinfandel, standing respectively at the two extremes, and the former containing nearly three times the amount of nitrogen found in the Zinfandel; their respective types also occupy the same relative position with respect to that grouping. The rest of the table speaks for itself in showing the average content and the relative position of the varieties with respect to nitrogen.

Differences between Individual Samples.—In this comparison the effect of varying climatic and soil conditions, as well as that of maturity, is shown in the very great differences not only between samples of different varieties, but in some cases between those of the same variety.

In glancing over the table as it stands we find at one extreme the Chauché noir, No. 1620, from Tulare, with the highest percentage of nitrogen in its must, viz., 0.188, while at the other extreme we find the Tannat and Marzemino, Nos. 1835 and 1231, with but 0.014%. In other words, the maximum of nitrogen is more than fourteen times greater than the minimum. In the entire list of 209 there are but 19 which have as much as 0.100% of nitrogen. As a matter of interest we place in order the ten highest and lowest respectively:

Highest in Nitrogen.			Lowest in Nitrogen.		
No. 1620.	Chauché noir	.188	No. 1525.	Carignane	.026
No. 1434.	Cinsaut	.177	No. 1230.	Robin noir	.026
No. 1446.	Chauché noir	.165	No. 1820.	Cabernet Sauvignon	.025
No. 1943.	Teinturier mâle	.141	No. 1284.	Chauché noir	.025
No. 1614.	Cinsaut	.140	No. 2174.	Mondeuse	.022
No. 1681.	Gros Verdot	.138	No. 1257.	Zinfandel	.021
No. 1302.	Tannat	.125	No. 1249.	Grenache	.020
No. 1298.	Chauché noir	.117	No. 1823.	Gamai Teinturier	.016
No. 1584.	Refosco	.112	No. 1231.	Marzemino	.014
No. 1332.	Pinot St. George	.110	No. 1835.	Tannat	.014

The table simply shows that while a sample such as the Chauché noir may stand highest in the amount of nitrogen in its must, another sample of the same variety is one of the other extremes. Evidently, other causes or conditions than mere variety influence the assimilation of nitrogen.

Seasonal Variations in Nitrogen.—There is naturally some variation in the amount of nitrogen absorbed from year to year by the same variety upon the same soil, and the extent of that variation for some of the varieties is shown in the following table:

TABLE SHOWING EXTREME SEASONAL VARIATIONS IN ONE AND THE SAME VARIETY.

No.	Variety.	Locality.	Vintage.	Nitrogen Per Cent.	Variation.
	Bordeaux Type.				
1113	Cabernet Sauvignon	Mission San José	1889	.097	.037
1342	Cabernet Sauvignon	Mission San José	1890	.060	
1554	Cabernet Sauvignon	Paso Robles	1891	.076	.014
1914	Cabernet Sauvignon	Paso Robles	1893	.062	
1443	St. Macaire	Tulare	1891	.079	.003
1846	St. Macaire	Tulare	1893	.076	
1295	St. Macaire	Mission San José	1890	.070	.015
1706	St. Macaire	Mission San José	1892	.055	
1560	Tannat	Paso Robles	1891	.079	.019
1911	Tannat	Paso Robles	1893	.060	
1489	Malbeck	Paso Robles	1891	.081	.004
1917	Malbeck	Paso Robles	1893	.077	
1547	Gros Mansenc	Paso Robles	1891	.063	.030
2083	Gros Mansenc	Paso Robles	1893	.093	
	Burgundy Type.				
1258	Pinot de Pernand	Mission San José	1890	.100	.003
1504	Pinot de Pernand	Mission San José	1893	.097	
1508	Pinot St. George	Mission San José	1891	.083	.013
1910	Pinot St. George	Mission San José	1893	.070	
1428	Robin noir	Mission San José	1890	.056	.006
1953	Robin noir	Mission San José	1893	.062	
1446	Chauché noir	Tulare	1891	.165	.023
1620	Chauché noir	Tulare	1892	.188	
1557	Chauché noir	Paso Robles	1891	.070	.009
1868	Chauché noir	Paso Robles	1892	.079	
	Southern French Type.				
1438	Serine	Tulare	1891	.103	.006
1814	Serine	Tulare	1893	.109	
1488	Serine	Paso Robles	1891	.072	.017
1895	Serine	Paso Robles	1893	.089	
1151	Mondeuse	Cupertino	1889	.080	.028
1312	Mondeuse	Cupertino	1890	.052	
1142	Mondeuse	Mission San José	1889	.088	.017
1334	Mondeuse	Mission San José	1890	.071	
1447	Carignane	Tulare	1891	.058	.017
1628	Carignane	Tulare	1892	.065	
1887	Carignane	Tulare	1893	.075	
1527	Grenache	Paso Robles	1891	.070	.020
1721	Grenache	Paso Robles	1892	.050	
1529	Petit Bouschet	Paso Robles	1891	.091	.012
2009	Petit Bouschet	Paso Robles	1893	.079	
1436	Aramon	Tulare	1891	.055	.006
1639	Aramon	Tulare	1892	.061	

Table Showing Extreme Seasonal Variations in One and the Same Variety—Continued.

No.	Variety.	Locality.	Vintage.	Nitrogen Per Cent.	Variation.
	North Italian Type.				
1445	Barbera	Tulare	1891	.094	.019
1675	Barbera	Tulare	1892	.075	
1554	Nebbiolo, or Spanna	Paso Robles	1891	.067	.018
1954	Nebbiolo, or Spanna	Paso Robles	1893	.085	
1958	Nebbiolo, or Spanna	Paso Robles	1893	.074	
1437	Crabb's Black Burgundy	Tulare	1891	.081	.007
1615	Crabb's Black Burgundy	Tulare	1892	.088	
	Hungarian Type.				
1071	Zinfandel	Amador station	1889	.043	.022
1257	Zinfandel	Amador station	1890	.021	
1440	Blue Portuguese	Tulare	1891	.104	.014
1618	Blue Portuguese	Tulare	1892	.090	

About four fifths of the varieties of musts just tabulated above show, for different seasons, very little variation in nitrogen percentage. The greatest variation occurs in the Cabernet Sauvignon—0.037% difference between the seasons of 1889 and 1890, grown at Mission San José. The Gros Mansenc shows the next largest difference—0.030% for the years 1891 and 1893, at Paso Robles. The smallest difference—0.003%—is shown in the St. Macaire of the years 1891 and 1893, from Tulare:

Regional Variations.—In preparing the following table, showing the results by regions, we have taken an average of the figures for nitrogen in must recorded in the large table (A) above, where more than one analysis occurred for one locality. In order to show the differences between musts of the same varieties of grapes grown on different soils in localities differing climatically, we have tabulated the nitrogen results according to the *agricultural regions*. These regions are fully described in the Reports of 1888–89 and 1892 of this station; and that part of the description relating to climate and soil is, in part, given here in the following quotations:

"The *Bay region* constitutes a climatic as well as a hydrographic and topographic feature; for, insignificant as the break formed by the Golden Gate may seem, it modifies profoundly the climate of the country lying adjacent and opposite to it, not only by the influence of its cool tide-water, but as well by the corresponding cool lower air-currents sweeping through it almost throughout the season, and carrying with them both the temperature and the moisture of the ocean, both modified by the cold Alaskan current. In summer, the river of fog, a mile wide, may be seen flowing in steadily through the Gate in the afternoon, first submerging the City of San Francisco, and then broadening and sending off branches right and left, up and down the bay, and toward the evening reaching the opposite shore where the Contra Costa range forms a barrier for a time. * * * The direct influence of this current extends about ten miles each way on the opposite shore, causing an exceptionally low summer temperature, which fails to ripen the grape and fig. Mission San José is located outside of this fog district on the east side.

"On the western shore of the bay the high ranges of the immediate coast form a barrier not surmounted by a considerable portion of the summer fogs; under the lee of these a warmer summer temperature prevails on the bay shore slopes. Cupertino is located on this part, and thus does not wholly lie without the fog-influenced district of the west side of San Francisco Bay.

"The *Southern Coast Range Valley region* is represented by the Paso Robles station, on the east side of the main Coast Range, outside the fog belt of the coast region, at an elevation of nearly 1,000 feet. This locality represents one of great fluctuation in temperatures (for the year 1892–93 the mean daily range in temperature was 30.18°). The atmosphere is dry, but owing to altitude the rainfall is greater (about 14 inches against 6 inches), and the average temperature lower than in adjacent portions of the great valley.

"The division of the *Great Valley region* traversed by the San Joaquin River constitutes about three fifths of the whole. The climate of the San Joaquin Valley stands in marked contrast to that of the immediate coast of California, and most markedly with that of the bay region contiguous to the Golden Gate. A very light rainfall, a very dry atmosphere, especially in summer (mostly below 50% of saturation), and a summer temperature which by the thermometer is very high, but which, in consequence of the dryness of the air, is but rarely oppressive, constitute the main factors of the climate of the interior valley.

"The climate of the *Sierra Foothill region* may be roughly said to be similar, as to temperature, to that of the adjacent portion of the Great Valley up to about 1,500 feet in its northern, and up to 2,000, and even more, in the southern part. Here, as in the valley, snow lies in the winter only for a few hours, or days, if it falls at all, and the fig and citrus fruits flourish. The summers are warm, the temperature very commonly rising into the nineties in the daytime; but, owing to the dryness of the air, this temperature is not oppressive, the more as the nights are always cool."

Nitrogen Contents of the Soils of the Several Regions.—Nitrogen occurs in soils in several combinations: in the humus in organic form, in the nitrates, and in the ammonia and ammoniacal salts. The soils of the several regions have been examined for nitrogen by this Station,* with results as shown in the following table:

NITROGEN IN SOILS OF VARIOUS REGIONS.

Region.		Humus Nitrogen, per cent on Soil.	Sodium Nitrate, ready-formed.
Sierra Foothills	Amador County, slate soil	0.090	------
	Amador County, granitic soil	0.100	------
Great Valley	Fresno, granitic soil	0.112	------
	Tulare, light sandy soil	0.062	0.067
Bay	Mission San José, heavy calcareous adobe soil	0.088	------
	Cupertino, gravelly clay loam soil	0.067	------
Southern Coast Range Valley	Paso Robles, sandy loam soil	0.100	------

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* "On the Nitrogen Contents of Soil Humus in the Arid and Humid Regions," by E. W. Hilgard and M. E. Jaffa, Report of Agricultural Experiment Stations, California, 1892–93–94, page 66. The nitrogen in the Cupertino soil has recently been determined by R. A. Gould, of the Agricultural Laboratory

Thus, the soils upon which the grapes under consideration were grown show some differences in soil nitrogen, especially that part contained in the organic form—that is, in the humus. The soils from Amador, Fresno, Paso Robles, and Mission San José all carry in the neighborhood of 0.100% of organic nitrogen. Those of Cupertino and Tulare resemble each other in this respect, having upward of 0.060% of organic nitrogen. But the Tulare soil possesses, in addition to its organic nitrogen, a supplement of nitrogen in the form of sodium nitrate (0.067% equivalent to 0.011% of nitrogen), wherein it differs from the soils of all the other regions. The introduction of the subject of soil nitrogen at this point is not, of course, to enforce any hard and fast rules relating to its influence upon grapes, because the data are insufficient and the whole subject is, as yet, a study.

TABLE B.—DIFFERENCES IN NITROGEN BETWEEN MUSTS FROM THE SAME VARIETIES OF GRAPES GROWN IN DIFFERENT REGIONS.

VARIETIES.	Foothills Region.	Great Valley Region.		Bay Region.			Coast Range Valley Region.
	Amador Co.	Fresno.	Tulare.	East Side, Mission San José.	West Side, Cupertino.	Napa Valley, Asti.	Paso Robles.
Bordeaux Type.							
Cabernet Sauvignon	.025	.036	.071	.077	.082	----------	.069
Cabernet Franc	----------	----------	----------	.088	.042	----------	.080
Gros Verdot	----------	.059	.138	.098	.041	----------	.091
Malbeck	.037	.063	.070	.092	.053	----------	.079
Tannat	.014	----------	.041	.125	.037	----------	.070
Teinturier mâle	.064	.063	.141	.102	.066	----------	.092
Gamai Teinturier	.016	.039	.089	.080	.047	----------	.082
St. Macaire	.041	----------	.077	.063	.056	----------	----------
Burgundy Type.							
Pinot de Pernand	----------	.101	.094	.098	.067	----------	.074
Pinot St. George	.040	.083	.057	.076	.110	----------	.067
Meunier	.043	.060	.063	.087	.043	----------	.047
Chauché noir	.030	----------	.176	.117	.065	----------	.074
Robin noir	.033	.026	.045	.059	.025	----------	.104
Southern French Type.							
Petite Sirah	----------	----------	----------	----------	.065	----------	.085
Serine	.051	.055	.106	.088	.061	----------	.081
Mondeuse	.022	----------	.056	.079	.066	----------	.068
Cinsaut	.044	----------	.155	.095	.056	----------	.077
Mataro	.040	.035	.042	.029	.049	----------	.076
Carignane	.032	.026	.066	.100	.050	----------	.049
Grenache	.032	.020	.064	----------	.053	----------	.060
Petit Bouschet	----------	.097	.060	.100	.094	----------	.079
Aramon	.040	.035	.058	.081	.060	----------	.055
César	----------	----------	----------	----------	----------	.072	----------
Austrian and Hungarian Type.							
Zinfandel	.032	.045	----------	----------	----------	----------	----------
Blue Portuguese	----------	.057	.097	.087	.061	----------	.077
Rothgipfler	.065	----------	----------	.063	----------	----------	.077
Marzemino	----------	.014	----------	.042	.065	----------	----------

TABLE B.—DIFFERENCES IN NITROGEN BETWEEN MUSTS FROM THE SAME VARIETIES OF GRAPES GROWN IN DIFFERENT REGIONS.—Continued.

VARIETIES.	Foothills Region.	Great Valley Region.		Bay Region.			Coast Range Valley Region.
	Amador Co.	Fresno.	Tulare.	East Side, Mission San José.	West Side, Cupertino.	Napa Valley, Asti.	Paso Robles.
Austrian and Hungarian Type—Continued.							
Grüner Velteliner		.041		.075	.047		
Kadarkas		.064		.107	.071		
North Italian Type.							
Gros Mansenc	.034	.050	.088	.087	.056		.079
Fresa	.034	.059	.049		.065		.086
Barbera			.084	.065	.085	.057	
Spanna, or Nebbiolo	.034				.042	.037	.078
Refosco				.112	.084		
Crabb's Black Burgundy		.081	.084	.091	.057	.042	.068
Dolcetto						.049	
Barolo						.064	
Bonarda			.071		.059		.079

A study of the figures in the table, as a whole, shows that the musts of grapes from Mission San José (Bay region) and Tulare (Great Valley) are the highest in nitrogen; those from Paso Robles in the Coast Range Valley stand second; those from Cupertino (on the west side of the Bay region) and those from Fresno (in the Great Valley) are third, while those from Amador (of the Foothills region) are the lowest in nitrogen. This is shown in the following table:

Must.	Mission San José.	Tulare.	Paso Robles.	Cupertino.	Fresno.	Amador Station.
Gros Verdot	.098	.138	.091	.041	.059	----
Tannat	.125	.041	.070	.037	----	.014
Chauché noir	.117	.176	.074	.065	----	.030
Robin noir	.059	.045	.104	.025	.026	.033
Petite Sirah	.088	.106	.081	.061	.055	.051
Aramon	.081	.058	.055	.060	.035	.040
Blue Portuguese	.089	.097	.077	.061	.057	----

It is interesting to compare results between Mission San José and Cupertino, two points comparatively few miles from each other in the same valley or Bay region, but situated respectively on the east and west side, and which possess some climatic differences.

Of the thirty-two different varieties of musts analyzed from these places, those from Mission San José contain the highest percentage of nitrogen in all but five samples, viz.: Cabernet Sauvignon, Pinot St. George, Mataro, Marzemino, and Barbera. In many instances the percentage of nitrogen is twice, and sometimes three times, that found in the Cupertino samples.

It might be expected, too, that the Fresno soil, situated as it is in the hot climate, where nitrification is most intense, would yield musts containing at least as much nitrogen as those from Tulare, in the same region. But the figures do not bear this out. Tulare musts rank in nitrogen, in almost every variety, far above those from Fresno.

These differences cannot be explained by the facts heretofore given relating to the soil nitrogen, for we find that both the light, sandy soil of Tulare and the heavy adobe of Mission San José have relatively small amounts of soil nitrogen to produce grape musts which are richest in nitrogenous matters. The foothill granite soil, with quite as much soil nitrogen as either the loamy soil of the Coast Range valleys or the granite soil of Fresno, fails in nearly every case to produce musts which even approach in nitrogenous matters those of the above districts. The foothill station soil in other respects, too, gives rather poor results with grape-varieties. The soil seems to be too dry to give good crops. From these facts before us, it seems that the nitrogen withdrawn by grapes and held in their musts does not stand in any direct relation to the total of the nitrogen contained in the soil itself.

European Analyses.—Some nitrogen determinations in musts from grapes grown in Europe have come under our observation. We give below part of the results obtained from those grown at the St. Michele Experiment Station, in Austria, and reported in "Landw. Versuchs. Stationen Nos. 36 and 41, Über den Gehalt an stickstoffhaltigen Substanzen in Trauben aus dem Anstaltsgute in St. Michele," by E. Mach and K. Portele.

NITROGEN IN EUROPEAN AND CALIFORNIA MUSTS.

	Vintage.	*Austrian Musts.	California Musts.
		Nitrogen Per Cent.	Nitrogen Per Cent (Average).
Cabernet Sauvignon	1891	.049	----
Cabernet Sauvignon	1889	.049	----
Cabernet Sauvignon	1889	.060	.065
Carbernet Franc	1889	.063	.070
Cabernet Franc	1888	.046	----
Merlot	1889	.037	----
Blauer Burgunder (Pinots)	----	.056	.081
Kadarkas	1889	.045	----
Kadarkas	1888	.027	.080
Lagrain	1889	.056	----
Lagrain	1888	.036	----

*Landw. Versuchs. Stationen (No. 41, 1892).

It will, of course, be borne in mind that the California grapes were not fertilized, while those at the Austrian station were, though perhaps not more than would offset the natural richness of our soils. Still, the Austrian varieties hardly show, on the whole, as much nitrogen as do our California musts. We notice, however, in the work referred to, that some of the Eastern American grapes grown at St. Michele yield some pretty high nitrogen percentages; namely, Jacquez (Lenoir), with 0.081%, and Herbemont, with 0.091%.

EXAMINATION OF THE WINES.

Of the one hundred and thirteen wines studied for this investigation and shown in Table A, quite one hundred were made in the viticultural cellar at this station; the remainder are marked as sent for examination. These station wines were all analyzed at the same age—from four to six months from making, or after being racked the second or third time. Their condition at that age, as recorded in this and previous viticultural reports, was generally *good*, the wines being bright, *i. e.*, having become cleared.

Nitrogen in Wines—Differences between Different Types.—The following table shows how the wines of the different types compare in their averages in nitrogen contents. Alongside of these we give the figures for the corresponding musts:

Type.	WINE.		MUST.		Nitrogen Lost during Fermentation. Per Cent.
	Number of Analyses.	Nitrogen Per Cent.	Number of Analyses.	Nitrogen Per Cent.	
Bordeaux	36	0.043	55	0.070	38.50
Burgundy	7	0.044	33	0.072	38.80
Southern French	44	0.037	61	0.064	42.20
Northern Italian	15	0.037	34	0.066	43.60
Austrian and Hungarian	11	0.036	22	0.060	40.00

The Bordeaux and Burgundy types of wines lead, as do their musts, in nitrogen. The other types—Southern French, North Italian, and Hungarian—show small differences between themselves, and here, again, they resemble their corresponding musts.

Differences between Varieties.—Comparing the averages of the varieties we find the Cinsaut, with its 0.090%, and the Chauché noir, with 0.071%, to rate highest, as is shown in the following table, in which nine of each extreme are given:

HIGHEST.			LOWEST.		
Variety.	Wine.	Must.	Variety.	Wine.	Must.
Cinsaut	.090	.132	Bonarda	.033	.063
Chauché noir	.071	.128	Aramon	.029	.059
Refosco	.056	.112	Grenache	.028	.043
Cabernet Sauvignon	.056	.073	Dolcetto	.027	.049
Gamai Teinturier	.055	.069	Zinfandel	.026	.039
Kadarkas	.054	.089	Pinot St. George	.026	.055
Nebbiolo or Spanna	.052	.085	Carignane	.025	.053
Petite Sirah	.052	......	Velteliner	.021	.058
Pinot de Pernand	.050	.100	Mataro	.017	.041

It is worthy of note that in the vinification, the Cinsaut lost camparatively little of its nitrogen, while the Chauché noir lost one third, and the Refosco still more. In the varieties with low nitrogen percentages the proportionate loss is still greater in some instances. Thus, the Grüner Velteliner and the Carignane have fallen more than one half, while of the Pinot St. George but one third of the original remains.

Differences between Individual Wines.—It does not follow, as a matter of fact, that the musts that contain the highest amount of nitrogen would give a wine which also ranks highest in the same; for the loss in vinification is unequal for the different samples. This is shown in the following table, in which ten samples at each extreme of nitrogen percentages have been compiled from the large general table first given:

HIGHEST.				LOWEST.			
Variety.		Wine.	Must.	Variety.		Wine.	Must.
No. 1434.	Cinsaut	.124	.171	No. 1243.	Gros Mansenc	.016	.050
No. 1620.	Chauché noir	.105	.188	No. 1189.	Aramon	.015	......
No. 1614.	Cinsaut	.093	.140	No. 1255.	Mataro	.015	.036
No. 1113.	Cabernet Sauvignon	.089	.097	No. 1253.	Zinfandel	.015	.030
No. 1418.	Kadarkas	.076	.107	No. 1257.	Zinfandel	.013	.021
No. 1497.	Teinturier mâle	.074	.092	No. 1252.	Mataro	.011	.035
No. 1142.	Mondeuse	.073	.088	No. 1246.	Aramon	.011	.035
No. 1302.	Tannat	.068	.125	No. 1189.	Aramon	.010	......
No. 1814.	Serine	.067	.109	No. 1525.	Carignane	.010	.026
No. 1618.	Blue Portuguese	.067	.090	No. 1251.	Carignane	.007	.026

The difference between the two extremes represented by Cinsaut and Carignane, respectively, is very great, the latter having but about one eighteenth as much nitrogen as the former. The great majority of the one hundred and thirteen samples of wines examined contain less than 0.050% of nitrogen.

Variations by Seasons.—It is interesting to note the differences in nitrogen contents that occur in wines from grapes of the same variety grown on the same plot in two consecutive seasons, and for convenience of comparison some of these are presented in the following table:

Nitrogen of Some Varieties of Wine from Grapes Grown on Same Plot in Different Years.

No.	Variety.	Locality.	Vintage.	Nitrogen Per Cent.	Variation.
1113	Cabernet Sauvignon	Mission San José	1889	.089	.047
1342	Cabernet Sauvignon	Mission San José	1890	.042	
1295	St. Macaire	Mission San José	1890	.023	.003
1706	St. Macaire	Mission San José	1892	.026	
1058	Gamai Teinturier	Mission San José	1889	.049	.005
1294	Gamai Teinturier	Mission San José	1890	.044	
1042	Serine	Fresno	1889	.044	.017
1242	Serine	Fresno	1890	.027	
1151	Mondeuse	Cupertino	1889	.056	.040
1312	Mondeuse	Cupertino	1890	.016	
1142	Mondeuse	Mission San José	1889	.073	.045
1334	Mondeuse	Mission San José	1890	.028	
1069	Mataro	Amador station	1889	.021	.006
1255	Mataro	Amador station	1890	.015	
1628	Carignane	Tulare	1892	.031	.004
1887	Carignane	Tulare	1893	.035	
1189	Aramon	Cupertino	1889	.015	.018
1414	Aramon	Cupertino	1890	.033	
1175	Aramon	Mission San José	1889	.042	.004
1377	Aramon	Mission San José	1890	.046	
1071	Zinfandel	Amador station	1889	.028	.015
1257	Zinfandel	Amador station	1890	.013	
1098	Zinfandel	Fresno	1889	.047	.032
1253	Zinfandel	Fresno	1890	.015	

As with the musts, so we find with the wines that the variations in nitrogen between two seasons for the same grape is in some cases very great and in others quite small. This is most noticeable in the Aramon, which at Cupertino differed by 0.018% for the seasons of 1889 and 1890, while at Mission San José for the same seasons the difference was only 0.004% of nitrogen. The Mondeuse, on the contrary, shows about equal differences (0.040% and 0.045%) for each of those localities. The Zinfandel also has a greater variation at Fresno than at Amador.

Effect of Nitrogen on the Keeping Quality of Wines.—The wines reported in the tables above were all made in the same manner; namely, by fermentation in open tanks, but covered with a floating cover and stirred twice a day, the outside temperature being kept at 75° F. We have already noted the differences between the different types of wines and their corresponding musts, but without reference to the *keeping qualities* of the wines. The types, from records here, when considered from the latter point of view, may be classified again: Bordeaux, *good keepers*; Burgundy, *not very good*; Southern French, *only fair*, on the whole; North Italian, *keeps very well*, as far as known; and the Hungarian, *rather well.* We find that the Bordeaux and Burgundy wines, which represent the extremes of both good and poor keepers, have in vinification each retained the largest part of their original nitrogenous matters. While the other types, viz.: Southern French, North Italian, and Hungarian, which are better than the Burgundy, have also retained about the same amount of their original nitrogen.

Among the *varieties* the Cinsaut, 0.090%, and Chauché noir, 0.071% of nitrogen, which are not rated as good keepers, average the highest in nitrogen-holding power, although having lost respectively 31.8% and 44.0% of their initial nitrogen.

The Cabernet Sauvignon, Refosco, Gamai Teinturier, and Spanna, with next highest nitrogen content, are all good keepers; the Petite Sirah, an exception to its type in being a good keeper, ranks with these in its nitrogen.

Of the wines retaining 0.050% of nitrogen (corresponding to 0.312% of albuminoids), the poor keepers are predominant, as represented by Pinot de Pernand, Robin noir, Serine, Petit Bouschet; and the Teinturier mâle, Verdot, and Tannats representing the better class.

The low nitrogen-holding varieties of wine (averages) are easily seen to be mostly in the class of wines with poor keeping qualities, as represented by the Pinot St. George, Carignane, and Grenache; however, the Zinfandels, good keepers, come in just at this point.

Of the *individual samples* we find that both the highest and the lowest nitrogen-holders belong to the class of wines of poor keeping qualities: The Cinsaut, No. 1434, retained 0.124% of nitrogen or 0.758% of albuminoids; the Chauché noir, No. 1620, 0.105% of nitrogen, corresponding to 0.656% of albuminoids. These have about ten times more albuminoids than the Carignane (Nos. 1251 and 1525), Mataro (No. 1252), Aramon (Nos. 1246 and 1189), and Pinot St. George (No. 1819), all with 0.010% of nitrogen or 0.063% of albuminoids; these, too, are poor keepers, or hard to keep until full maturity without special precautions. No. 1312, Mondeuse, with 0.016% of nitrogen or 0.100% of albuminoids, is an exception to its type, in being a good keeper; No. 1243, Gros Mansenc, with the same amount of nitrogen, keeps well also.

The large number of wines intermediate between the extremes just discussed are quite evenly distributed between good and only fair keepers; occasion to study them more fully will be taken when we refer to the influence of locality upon their nitrogen contents.

From the foregoing we are able to emphasize our first conclusion: that the inference is rather against the significance of the *amount* of nitrogen present as controlling the keeping qualities of wines. This is shown especially in samples of the Mondeuse, which, in 1889, had a high content of nitrogen, and in 1890 a very low percentage, and yet their records show that they were in each case both very fair keepers. The influence, so far as it goes, probably lies more in the direction of the *quality* than of the *quantity* of nitrogenous ingredients.

Influence of Locality.—For the purpose of considering the influence of locality upon the nitrogen held in wines of the same and different varieties, we group them according to regions in the accompanying large table, which shows the nitrogen per cent in the must and the wine, and the differences between the must and the wine expressed in figures for absolute amount, and per cent upon original nitrogenous contents.

The differences in the nitrogenous matters of the musts and wines for localities may, for convenience, be stated in this general way, from the results shown by the table: The wines of the Foothills region (average of 6 samples) have lost 50% during fermentation, those of the Valley (average of 27) 41.90%, of the Bay (average of 44) 46.80%, and of the Coast (average of 15) 43.60% of their initial nitrogen. However, as these figures relating to wine are based upon extremely variable results for the different regions, even the differences between the same wines grown in any one locality are notable, so that it becomes quite necessary to examine some of the results carefully.

Take, for instance, the Teinturier mâle from the three greater districts; we find the Coast sample of wine, No. 1497, to have been deprived of 19.50% of its original nitrogen during fermentation, as against 43.20% for the Bay wine, No. 1292, and 54.10% for the Valley wine, No. 1205.

The Gros Mansenc of the three regions, on the whole, offers an example of rather similar figures in loss of nitrogenous matters, viz.: Valley, 56%; Bay, 53%; Coast, nearly 48%. The Chauché noirs from Bay and Coast Range valleys have parted with rather more nitrogen than the Valley wine, for they show a little over 50% loss as against 44.10%; the must of the Chauché noir of the Valley contained 0.108% of nitrogen, that from the Bay 0.117%, and that from the Coast Range valleys 0.079%—all high quantities.

The Serine wines of the various localities are rather constant than otherwise in loss of nitrogenous matters, as witness: Coast, 42.50%; Bay, 46.90%; and Valley, average, 45.0%—with quite similar and high amounts in their musts.

The Mondeuse wines from the Bay region are very erratic, losing all the way from 17% to 60% of nitrogenous matters, but averaging about 50%, as against 57% for the Valley and 47% for the Coast Range valleys.

The Mataros, with the exception of those of the Coast Range valleys, began fermentation with quite similar amounts of nitrogenous matters, and yielded, in the end, wines with some variations for the separate regions; the Foothill and Bay musts have lost about 56%, the Valley and Coast, each upward of 69%.

Of the Aramons, the Valley samples of wine have lost the largest amount of nitrogenous matters during fermentation, averaging over 57% loss; the Bay and Coast lots have retained more of the ingredients, having lost, respectively, 43.30% and 45%. Crabb's Black Burgundy (Refosco) shows the Coast wine to hold much more nitrogenous matter than the Bay or Valley wines of this name; and we may call attention to the fact that the Bay district presents rather wide ranges in nitrogen of musts, and also in amount of nitrogen retained after fermentation.

The Zinfandel wines from the Valley differ greatly in nitrogen eliminated during fermentation, No. 1098 having lost about one fourth and No. 1253 just one half; the Foothill wines, on the other hand, show more uniform loss, and average 36.70% loss.

Thus it appears that in carrying this work forward we have found

TABLE C—NITROGEN IN WINES OF DIFFERENT REGIONS.

Serial Number	VARIETIES.	SIERRA FOOTHILLS REGION.				GREAT VALLEY REGION.								BAY REGION.								COAST RANGE VALLEY REGION.			
		Amador Station.				Fresno.				Tulare.				Mission San José.				Cupertino.				Paso Robles.			
		Nitrogen Per Cent.		Differences in Must and Wine.		Nitrogen Per Cent.		Differences in Must and Wine.		Nitrogen Per Cent.		Differences in Must and Wine.		Nitrogen Per Cent.		Differences in Must and Wine.		Nitrogen Per Cent.		Differences in Must and Wine.		Nitrogen Per Cent.		Differences in Must and Wine.	
		In Must	In Wine	Absolute	Per Cent.	In Must	In Wine	Absolute	Per Cent.	In Must	In Wine	Absolute	Per Cent.	In Must	In Wine	Absolute	Per Cent.	In Must	In Wine	Absolute	Per Cent.	In Must	In Wine	Absolute	Per Cent.
	Bordeaux Type.																								
1113	Cabernet Sauvignon													.097	.089	.008	8.2								
1342	Cabernet Sauvignon													.060	.042	.018	30.0								
1705	Cabernet Sauvignon													.075	.038	.037	49.3								
1914	Cabernet Sauvignon																					.062	.055	.007	11.2
1382	Gros Verdot													.098	.052	.046	46.9								
1797	Malbeck									.070	.053	.017	24.2												
1917	Malbeck																					.077	.047	.030	38.9
1302	Tannat													.125	.068	.057	45.6								
1911	Tannat																	.060	.026	.034	56.6				
1283	Teinturier mâle																	.066	.035	.031	47.0				
1205	Teinturier mâle					0.63	.029	.034	55.5																
1497	Teinturier mâle																					.092	.074	.018	19.5
1292	Teinturier mâle													.102	.058	.044	43.1								
1270	Gamai Teinturier																	.047	.023	.024	51.0				
1291	Gamai Teinturier													.080	.044	.036	45.0								
1806	Gamai Teinturier																					.082	.043	.039	47.5
1281	St. Macaire																	.056	.024	.032	57.1				
1285	St. Macaire													.070	.023	.047	67.1								
1706	St. Macaire													.055	.026	.029	52.7								
1846	St. Macaire									.078	.041	.035	46.0												
	Burgundy Type.																								
1258	Pinot de Pernand													.100	.050	.050	50.0								
1010	Pinot St. George													.070	.033	.037	52.8								
1819	Pinot St. George	.040	.019	.021	52.5																				
1298	Chauché noir													.117	.056	.061	52.0								
1868	Chauché noir																					.079	.038	.041	52.0
1620	Chauché noir									.188	.105	.083	44.1												
1953	Robin noir													.062	.049	.013	20.9								
	Southern French Type.																								
1341	Serine													.088	.047	.041	46.6								
1242	Serine					.055	.027	.028	51.1																
1814	Serine									.109	.067	.042	38.5												
1895	Serine																					.089	.054	.035	39.3
1312	Mondeuse																	.052	.016	.036	69.2				
1151	Mondeuse																	.080	.056	.024	30.0				
1142	Mondeuse													.088	.073	.015	17.0								
1334	Mondeuse													.071	.028	.043	60.5								
1888	Mondeuse									.056	.024	.032	57.1												
1922	Mondeuse																					.068	.036	.032	47.0
1408	Cinsaut													.095	.053	.042	44.2								
1434	Cinsaut									.171	.124	.047	27.4												
1914	Cinsaut									.140	.093	.047	33.5												
1069	Mataro	.045	.021	.024	53.3																				
1255	Mataro	.036	.015	.021	58.3																				
1609	Mataro																	.049	.019	.030	61.2				
1610	Mataro													.029	.010	.019	65.5								
1257	Mataro					.035	.011	.024	68.5																
1921	Mataro																					.076	.023	.053	69.7
1070	Carignane	.032	.011	.021	65.6																				
1251	Carignane					.026	.007	.019	73.3																
1628	Carignane									.065	.031	.034	52.3												
1656	Carignane																					.049	.033	.016	32.6
1777	Carignane									.075	.035	.040	53.3												
1340	Grenache					.020	.015	.005	25.0																
1626	Grenache									.060	.041	.019	31.6												
1721	Grenache																					.050	.028	.022	44.0
1358	Petit Bouschet													.100	.052	.048	48.0								
1425	Petit Bouschet									.060	.045	.015	25.0												
1860	Petit Bouschet																					.079	.051	.028	35.4
1411	Aramon																	.060	.033	.027	45.0				
1577	Aramon													.081	.046	.035	43.2								
1246	Aramon					.035	.011	.024	68.5																
1629	Aramon									.061	.032	.029	47.5												
	Austrian and Hungarian Type.																								
1262	Blue Portuguese													.087	.042	.045	51.7								
1266	Blue Portuguese					.057	.025	.032	56.1																
1618	Blue Portuguese									.090	.067	.023	25.5												
1346	Gruner Veltliner													.075	.025	.050	66.6								
1598	Gruner Veltliner					.041	.017	.024	58.5																
1507	Kadarkas																	.071	.032	.039	54.8				
1418	Kadarkas													.107	.076	.031	28.9								
1098	Zinfandel					.061	.047	.014	22.9																
1254	Zinfandel					.030	.015	.015	50.0																
1071	Zinfandel	.043	.028	.015	34.8																				
1257	Zinfandel	.021	.013	.008	38.0																				
	North Italian Type.																								
1579	Barbera													.065	.034	.031	47.7								
1675	Barbera									.075	.032	.043	57.3												
1954	Nebbiolo, or Spanna																					.085	.052	.033	38.8
1584	Refosco													.112	.056	.056	50.0								
1318	Crabb's Black Burgundy																	.057	.030	.027	47.3				
1343	Crabb's Black Burgundy													.091	.041	.050	54.9								
1615	Crabb's Black Burgundy									.088	.040	.048	54.4												
1196	Crabb's Black Burgundy																					.068	.047	.021	30.8
1384	Bonarda																	.055	.023	.032	58.1				
1362	Bonarda																	.055	.035	.020	36.3				
1869	Bonarda																					.079	.045	.034	43.0
1277	Gros Mansenc																	.056	.028	.028	50.0				
1339	Gros Mansenc													.087	.038	.049	56.3								
1243	Gros Mansenc					.050	[illegible]	.031	68.9																
1899	Gros Mansenc									.088	.049	.039	44.3												
2083	Gros Mansenc																					.093	.049	.044	47.3

abundant examples to verify the earlier statements in regard to the influence of climate and soil upon the nitrogen contained in grape musts, viz.: "that while climate exerts a material influence upon the nitrogen contents of all grape musts, and especially upon the loss of nitrogen in vinification, a very great influence must also be ascribed to the soil, although the differences are not equal, or proportional, in different grape-varieties. It does not appear that the total amount of nitrogen present in grape musts bears any direct relation to the known keeping qualities of the wines, whether we compare different varieties, or the same variety from different localities." And until we have determined in what condition the nitrogen exists in wines, it is impossible to specify the influence, if any exists, that nitrogenous matters have upon the conservation of wines. The subject is an exceedingly complicated one, because, as yet, there is no reliable method for the separation of the various nitrogenous bodies known as "albuminoids," peptones, amides, etc.

THE INFLUENCE OF DIFFERENT METHODS OF VINIFICATION UPON THE NITROGENOUS CONTENTS OF WINES.

This is illustrated in the results given in the following table. These experiments, an account of which was published separately in 1888 (see "Report of Experiments on Methods of Fermentation"), showed amazing differences in composition as the result of varying the methods of vinification. Without entering upon the details of these methods, some salient points may be mentioned.

The material employed was Carignane grapes from Mission San José, Alameda County, the locality which in the preceding discussion has been found to produce wines so exceptionally rich in nitrogenous compounds. It did not belie its reputation with the Carignane used, which, when vinified according to our usual method (in open tank with floating cover and twice-daily stirring, and outside temperature of 75° F.), showed 0.081% of nitrogen against 0.011% found in the wine of the same grape grown in Amador County—an enormous difference.

TABLE D.

DETERMINATION OF NITROGEN (*Resp.* "ALBUMINOIDS") IN WINES (CARIGNANE, AGE 2½ YEARS) FROM EXPERIMENTAL FERMENTATIONS, VINTAGE OF 1887.*

Number.	Mode of Fermentation.		Nitrogen.	"Albuminoids."
			(March, 1890.)	
795	Floating cover, twice-daily stirring, 90°–95° F.		.098	.613
787	Floating cover, twice-daily stirring	72°–75° F.	.081	.508
788	Single frame, near top of mash		.099	.619
789	Single frame, near middle of mash		.102	.638
790	Single frame, pumping over the wine from below		.085	.531
791	Three frames, at different heights		.095	.594
792	No cover, twice-daily stirring		.096	.600
793	No cover, stirring by pumping air		.077	.481
794	"Morel process" (whole grapes)		.088	.551
796	Floating cover, twice-daily stirring, 62° F.		.097	.606

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*See Report on "Experimental Fermentations," 1888.

The maximum of nitrogen (0.102%) was found in the wine made according to the somewhat laborious, but thoroughly rational, method of keeping the pomace-cap submerged far below the surface of the liquid (No. 789), preventing acetification, and producing a wine of markedly good character, both as to bouquet, softness, and keeping qualities. The minimum (0.077%) was obtained when employing a rather excessive amount of aëration, by not only leaving the surface of the wine exposed, but also pumping air through it thrice daily, instead of stirring with the usual implement (No. 793). That this aëration brings about a precipitation of nitrogenous substances has been known ever since the experiments on the D'Heureuse method of defecating vegetable juices, and was to be expected in this case. But owing to the excessive exposure to the air, the wine so prepared of course did not keep well.

The relative effect of *lack of aëration* is shown also in the result of the process (No. 788), in which a single grated frame is made to hold the pomace-cap near the surface of the liquid, although submerged; no stirring being done, and therefore no aëration beyond what occurs at the surface, where the small amount of fluid retained there usually becomes acetified. Its nitrogen percentage (0.099) is greater by 0.018 than that of the wine made by our usual process (No. 787), which received a moderate amount of aëration by stirring.

The most unexpected result shown in the table is that of the fermentation at the high temperature of 90° to 95° F., which gave to the resulting wine the same amount of nitrogenous matter as the one conducted, otherwise similarly, but at the temperature of only 62° F. It has been thought that the higher temperature might tend to the dissolution of more albuminoids, and that this might have some connection with the poor keeping qualities of the wines produced, under the influence of heat, in warm climates; but this experiment seems to prove that this is not the case.

NITROGEN IN CALIFORNIA WINES OF MORE ADVANCED MATURITY THAN THE ABOVE.

Below, in the small table, is given the nitrogen contained in California wines exhibited at the World's Columbian Exposition, at Chicago; analyzed by Mr. W. H. Krug, of the U. S. Agricultural Department, Chemistry Division, Washington, D. C.:

Nitrogen in Older California Wines.

Wine.	Nitrogen.		"Albuminoids."	
	Maximum.	Minimum.	Maximum.	Minimum.
Zinfandel	0.084%	0.028%	0.525%	0.175%
Clarets	0.093	0.027	0.580	0.169
Cabernet	0.081	0.030	0.506	0.188
Malbeck	0.091	0.048	0.556	0.030
Medoc	0.058	0.039	0.363	0.238
Burgundy	0.074	0.030	0.450	0.188
Mataro	0.093	0.025	0.581	0.156
Barbera	0.032		0.200	
Barolo	0.014		0.094	
Mondeuse	0.034		0.213	

No accurate comparison, on account of differences of age, can be made between these results and most of those in Table A. However, the results for the older wines show, like the very young ones, wide differences in their nitrogen. The Cabernets from Gubserville, noted elsewhere as exceptions in point of age, are comparable with those analyzed by Mr. Krug. In the series embracing 1632R to 1635R, Table A, the nitrogen varies from 0.035% to 0.057%, as against 0.030% to 0.081% for those examined in Washington, from various California localities.

Taking the oldest Cabernet wines, vintage of 1885, of both series examined for nitrogen, we find for that from Gubserville 0.041%, as against 0.037% of nitrogen in that from Napa, No. 12762 of the analysis by Mr. Krug.

NITROGEN IN SOME EUROPEAN WINES.

The following list comprises some of the determinations of nitrogen in wine of various European sources. Selection has been made with a view to comprehend some similarity of *type* and *variety* between these and the California wines examined. But, on account of great difference in age of the wines examined, the comparisons we can make are necessarily not very accurate.

NITROGEN IN SOME EUROPEAN WINES.

Name and Source of Wine.		Nitrogen Per Cent.	Name and Source of Wine.	Nitrogen Per Cent.
**French Wines.*			†*Italian Wines.*	
Grand wines	Côtes rôties	.042	Nebbiolo	.011
	Pouilly	.081	Nebbiolo	.012
	Pomard	.050	Bonarda	.017
	Pomard	.074	Dolcetto	.010
	Beaune	.054	Dolcetto	.017
	Closvougeot	.080	Dolcetto	.013
	Richebourg	.052	Pinot	.001
	Nuits Saint George	.127	Barbera	.007
	Nuits Saint George	.124	Barbera	.014
	Nuits Saint George	.106	Barbera	.017
			Barbera	.020
Common wines	Alicante	.016	§*Tyrol Wines* maximum	.030
	Narbonne	.009	minimum	.012
	Gamai Beaune	.024	§*Lower Austria Wines* maximum	.030
	Bouschet Mouvèdre d'Arles	.001	minimum	.023
	Aramon (Arles)	.001	§*Dalmatia Wines* maximum	.030
	Carignane (Arles)	.001	minimum	.011
	Carignane (Arles)	.003	§*Hungarian Wines* maximum	.045
	Carignane (Arles)	.001	minimum	.010
	Petit Bouschet (Arles)	.001	‡*Austrian Wines.*	
	Alicante Bouschet	.001	Cabernet	.016
			Kadarkas	.017
			Marzemino	.018

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* From "Étude sur la fermentation alcoolique du vin," par V. Martinand; Marseilles, 1893.

† "Ministero di Agricoltura, Industria E Commercio": Italy; Report of 1896.

§ Appendix B, Report of State Viticultural Commission, 1893–94. (Extracts from Report U. S. Dept. of Agr., Washington.)

‡ Landw. Versuchs. Stationen, No. 36, 1889.

The French wines designated as *Grand Wines* by V. Martinand all carry high nitrogen percentages, while those named by him *Common Wines* are all low in that respect. The latter class seem to resemble, in low nitrogen contents, the wines of Austria and Italy, as given above.

As far as it is possible to compare the figures just above for the European wines with those in Table A, we can say that, with the exception of the high-grade French wines, the nitrogen of the California wines seems to be much higher, on the whole, than that contained in wines produced in the eastern and southern grape-growing regions of Europe. In northern Europe, too, this seems to hold, for the nitrogen, as far as observed, ranges from 0.010% to near 0.030%.

SUMMARY.

(*a*) *Musts.*—(1) The variation in average amount of nitrogen in the musts of the various types is confined to very narrow limits. (2) The *maximum* amount of nitrogen in the series of musts examined is over fourteen times greater than the *minimum*, or 0.188% as against 0.014% of nitrogen. (3) The greater part of the musts from grapes grown on the same plots, in different years, take up nearly the same amount of nitrogen each year. (4) The grapes from Tulare in the Great Valley, and from Mission San José of the Bay region, contain in their musts the highest nitrogen; the Coast Range Valley (Paso Robles) musts stand next; the Sierra Foothills musts are lowest, while Fresno (Valley) and Cupertino (Bay) musts stand intermediate between these and the Coast Range Valley. (5) The nitrogen withdrawn from the soil by grapes and held in their musts does not stand in any direct relation to the available *soil* nitrogen.

(*b*) *Wines.*—(1) The highest nitrogen averages in wines are found in the Bordeaux and Burgundy types as given. The other types examined contained, on the average, somewhat less than these, but resemble each other greatly. (2) Wines from the same grapes grown on the same plots in different seasons do not, on the whole, show much similarity in nitrogen. (3) The *maximum* amount of nitrogen found in wine is 0.124%, and the *minimum* was 0.007%. (4) The inference is rather against the significance of the amount of nitrogen present as controlling the keeping qualities of the wine. The influence, as far as it goes, probably lies more in the direction of the quality than of the quantity of the nitrogenous matters.

General Conclusions.—While the climate exerts a very great influence upon the nitrogen contents of all grape-musts, and especially upon the loss of nitrogen during vinification, a very great influence must also be ascribed to the soil; although the differences are not equal, or proportional, in different grape-varieties. It does not appear that the total amount of nitrogen present in grape-must bears any direct relation to the known keeping qualities of the wines, whether we compare different varieties or the same variety from different localities; and, until we have determined in what condition the nitrogen exists in the wine, it is impossible to define the influence, if any exists, that nitrogenous matters have upon the conservation or quality of wines. The subject is an exceedingly complicated one, because, as yet, there is no reliable method for the separation of the various nitrogenous bodies known as "albuminoids."

In those wines that show very wide differences in nitrogen contents in musts and wines there is probably a larger proportion of "albuminoids," while those with proportionately small amounts may be supposed to contain chiefly amido and imido compounds.

MISCELLANEOUS NOTES.

By F. T. Bioletti.

PRESERVATION OF FRESH GRAPES.

For four months in the year grapes are plentiful and cheap in California; for the other eight they almost disappear from the market. It is, therefore, very desirable to find some inexpensive and practicable way of keeping fresh grapes for as much of these eight months as possible. If this could be done it would be very profitable, as grapes kept till late spring or summer would increase three-fold in value.

In keeping grapes for any length of time there are two main dangers to be avoided—*drying up* and *mold*. If the grapes shrivel from loss of moisture they lose their character of fresh grapes and resemble raisins. If they are attacked by mold they are lost. Grapes for keeping should be handled with the greatest care. They should not be touched by the hand at all. In picking they should be handled by taking hold of the stem and laying them on straw, not allowing any bunch to lie on another. Only perfect and preferably loose bunches should be taken, all defective or bruised berries being carefully removed with a pair of scissors. The reason for such great care in handling is that the skin of the berry cracks very easily at the junction of the pedicel. This crack is often so small that it would not be noticed without careful scrutiny, but it gives an opening for molds and yeasts to enter the grape. A few grapes may start a growth of mold that soon envelops the whole bunch. It is also very desirable to retain as much as possible of the bloom of the grapes, and to do this there must be the minimum possible amount of contact between them and the hands.

Certain tough-skinned grapes strongly attached to the pedicel may be kept without much difficulty till Christmas or the middle of January by simply hanging them up or laying them on straw in a fairly dry room of even and low temperature. By January, however, they become much shriveled. Some fleshy grapes, such as the Almeria or Tokay, do not show the effects of loss of water so quickly. By the Thomery method of keeping a piece of vine wood, attached to the bunch, in a vessel of water, the grapes may be kept several weeks longer. This method, however, is troublesome and expensive; the water must be kept disinfected by wood-charcoal, and the bunches gone over carefully very often to remove decaying berries.

The Spanish method of packing the grapes in cork-dust is excellent for very hard grapes, such as the Almeria, but does not do for more delicate varieties. On account of the expense of cork-dust, attempts have been made to use sawdust as a substitute. There are several strong objections to its use, however. Even the most odorless sawdust communicates a taste to grapes after a few months. The hygroscopic nature of sawdust is very much against its use, especially if it is fine. If too dry it extracts moisture from the grapes, and if moist it favors the growth of mold. A process of treatment invented by Mr. Shepard seems likely to overcome both these objections.

All these methods aim to protect the grapes from mold by surrounding them with a dry atmosphere, and all fail to keep any but the coarsest varieties for the full eight months, on account of the drying up of the moisture in the berries. Other methods have been tried, the leading principle of which is to keep the grapes in an atmosphere saturated with moisture, thus preventing all shrinkage, and to avoid mold by the use of a very low temperature or antiseptics. Sulphurous acid gas preserves the grapes from mold without injuring their appearance, except for a slight bleaching, but the grapes soon contract a sulphurous taste, besides having their natural one destroyed, thus rendering them uneatable. The use of an atmosphere saturated with alcohol fumes has been tried in France, it is said, with great success. According to experiments made here, however, it is hardly to be recommended. Finally, the use of carbonic acid gas has been tried. The last is the most promising, judging by the few experiments made here.

Experiments at this Station.—During the vintage of 1894 an attempt was made to preserve grapes in sawdust. The varieties experimented on were Napoleon, Zabalkanski, Huasco, Muscat of Alexandria, and Purple Cornichon from Tulare. Spruce sawdust was used, as having comparatively little taste. The sawdust was spread out in a thin layer and exposed to the sun until quite dry. It was then allowed to cool, and used to pack the grapes in the boxes at the vineyard. The packed grapes were then shipped to Berkeley, where they were allowed to remain in the same boxes. They arrived in perfect condition on November 1st. They all kept fairly well for a month; after this they commenced to decay or shrivel. At six weeks the Huasco and Muscat were all decayed. The Cornichon was less attacked by mold, but soon shriveled. The Napoleon and Zabalkanski kept best, but in two months none of them were in marketable condition. Even those which were not decayed had a slight mawkish taste due to the sawdust. The results, then, were inferior to those already obtained by keeping the grapes on straw or hung up on strings. This is partly owing to the impossibility of removing the decayed grapes before they infect the others.

In order to make a preliminary test of the relative merits of alcohol vapor, carbonic acid gas, and sulphurous fumes, the following experiments were made at the laboratory:

No. 1. A bunch each of Sultana, Gros Colman, and Verdal were hung up in a box made of a five-gallon coal-oil can. The grapes were received on September 30, 1895, from Tulare. They were washed with a spray of water and put immediately into the box. A small, wide-mouthed, two-ounce bottle of alcohol was put in the bottom of the box, which was hermetically sealed with paraffine. All the grapes kept their appearance perfectly for five months, only a few turning brown. At the end of nine months most of the white grapes had turned brown, but the Gros Colman looked as if they had been just picked from the vines. They all, however, tasted strongly of alcohol and somewhat of vinegar. Many of the Verdal berries had fallen off the bunch. There was no mold on any of them. The turning brown seems to have been caused by a small yeast or torula which enters the grapes at the junction with the pedicel.

No. 2. Four bunches of Black Prince and Mission grapes received from Tulare, September 30, 1895, were placed in a box similar to that used in experiment No. 1. The only difference of treatment was that the grapes were dipped in a weak solution of sulphurous acid before being hung up. The results were similar, except that fewer berries turned brown. They all, however, had acquired a strong taste of alcohol and vinegar, which made them unfit for eating. The appearance of the Mission grapes was particularly fine. At the end of nine months they looked as though just picked from the vine, being unshriveled and covered with bloom.

On November 2, 1895, another series of experiments was made. The grapes used were Pizzutello, Purple Cornichon, Flame Tokay, and Zabalkanski from Tulare. Five tin boxes were prepared in the same way as for the first two experiments, and a bunch of each variety placed in each box. The boxes were covered inside and out with a coating of paraffine to prevent rusting.

No. 3. The box was left open to the air as a control test. In nine days the Pizzutello grapes were turning brown and, with the Tokay, were becoming moldy. The Zabalkanski and Cornichon were still in good order. In twenty days all the grapes were moldy.

No. 4. Sulphur was burned in the box as soon as the grapes were put in, in order to sterilize them. The next day the box was filled with carbonic acid, and hermetically sealed. At nine and at twenty days all the grapes were good. At two months some of the gas had leaked out, but the grapes were all in good order and the box was refilled with carbonic acid. At the end of four months all the grapes appeared good, showing no sign of rotting or mold. They were as plump as when put in, showing no sign of cracking or shriveling. Even the delicate skin of the Pizzutello was uninjured. All of them, however, had acquired a strong taste of the paraffine with which the box was coated. At the end of nine months the grapes were still in the same condition, except that a few were becoming moldy on account of a small crack in the cover, through which mold spores had obtained entrance.

No. 5. This was a repetition of experiment No. 2, and gave the same results.

No. 6. After the grapes were put in the box, sulphur was burned beneath them and the box hermetically sealed. All the grapes were good at the end of twenty-two days, when a stream of sulphur fumes was drawn through the box. At the end of four months the grapes were all good, except that they had the same disagreeable taste of paraffine, which spoiled the grapes in experiment No. 4. At the end of nine months there was little change. The colored grapes were a little bleached and some of the white grapes had turned brown. The Cornichon and Tokay looked as well as when gathered, but the Pizzutello and Zabalkanski were inferior in appearance to those in the carbonic-gas experiment.

No. 7. This was identical with No. 4, except that a little alcohol and corrosive sublimate were placed at the bottom of the box. The results for the first four months were the same as in experiment No. 4, but after this the grapes became moldy, on account of a leak in the box.

Analyses of Must of Preserved Grapes, June 29, 1896.

Name.		Sugar by Copper Test.	Acid as Tartaric.
Black Prince	Experiment No. 2	14.70%	0.99%
Mission	Experiment No. 2	13.30	0.68
Corinchon	Experiment No. 4	16.90	0.23
Corinchon	Experiment No. 6	17.90	0.26
Zabalkanski	Experiment No. 6	18.20	0.49
Pizzutello	Experiment No. 6	18.60	0.21
Flame Tokay	Experiment No. 6	19.90	0.25

These experiments, although in no case successful in preserving grapes in perfectly marketable condition, are very promising, and show that at least their appearance can be kept perfect. They show also the ease with which grapes, under the conditions of the experiments, take up odors, and the necessity of keeping them protected from anything that is liable to give them a bad flavor. It is for this reason that the use of carbonic acid gas will, in all probability, be preferable to the use of either alcohol or sulphur fumes. As may be seen from the above table of analyses, made by Mr. G. E. Colby, in experiments Nos. 4 and 6 the grapes had maintained their usual sugar and acid contents practically unchanged, showing that no appreciable effect had been caused by molds or yeasts. In experiment No. 2, however, there had been a notable decrease of sugar due to fermentation, and increase of acid due to acetic bacteria.

SUNSTROKE OF THE VINE.

At the beginning of August, 1895, complaints were received from Fresno that a large number of isolated vines were dying of some unknown disease. At the request of Mr. Owen, manager of the Butler estate, a visit was made to the vineyard and the trouble investigated.

In various parts of the tract, isolated vines were losing their leaves, the grapes were being destroyed by the sun, and in the worst cases the vines were killed. Mr. Owen, under the impression that the vines were attacked by some kind of mildew, had sprayed them with Bordeaux mixture, and believed that he had succeeded in arresting the evil; of this, however, no evidence could be seen.

The symptoms of the disease were the following: The leaves gradually, or sometimes rapidly, dried up and fell off, leaving the shoots exposed and allowing them to be killed by the sun. The vines first showed effects of the trouble in the early part of the summer, and some of those first attacked, though losing all their leaves, partly recovered and sent out new leaves. The leaves when first attacked often became spotted in a way somewhat resembling the Anaheim disease, but with the important difference that the line between the healthy tissue and the dead was clearly marked with little or no diseased tissue between. The appearance of the leaves is fairly well shown in the accompanying figure taken from a photograph.

The specimens of leaves and fruit brought to Berkeley were examined, but no sign of fungous parasites could be found. The trouble occurred equally in all parts of the vineyard on young and on old vines, but

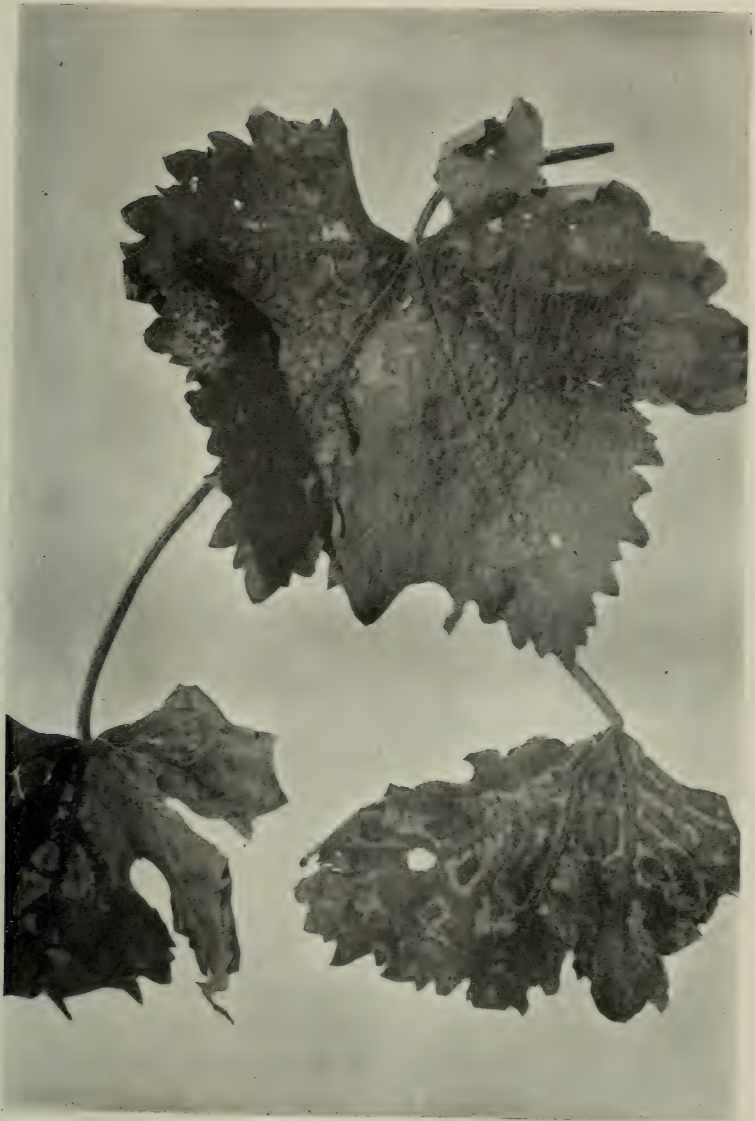

Plate III. Leaves of Vines Injured by Sunstroke.

much more on the Muscats than on the stronger-growing Sultanas. The trouble is apparently simply a drying up of the vine, caused by a lack of adjustment between the water evaporated from the leaves and that taken up by the roots. The primary cause is probably the abrupt changes in the bottom water-level.

The trouble is that known in France as "folletage," and is physiological and not properly pathological in its character. It is thus described by G. Foëx: "Folletage occurs ordinarily in July or August, on vines which, up to the time of attack, have been healthy and vigorous. There are no preliminary symptoms. Isolated vines or patches of vines show a wilting of the leaves, which gradually fade and die; the shoots commence to dry up from the tips, and soon the whole vine dies. Sometimes the vine is less severely attacked and does not die. It receives, however, a severe check, from which it rarely recovers completely. It is particularly common in rich, deep soils which are damp and where the water-level is high, especially in wet years, and when the soil is poorly drained."

It may be caused by anything which disturbs the equilibrium between the water evaporated from the leaves and that taken up by the roots. A sudden period of dry, hot weather may cause more evaporation from the leaves than can be counteracted by the absorbing action of the root hairs. A sudden rise or fall of the water-level may cause the destruction of the root hairs, and thus render the vine incapable of replacing the evaporated water. In the case of the Fresno vines it is doubtless a combination of these two conditions that is responsible for the damage. There is practically no cure if the vine is badly affected. It is, therefore, very important to avoid the evil by careful management of irrigation and a close attention to the water-level.

BOTRYTIS CINEREA.

The *Botrytis cinerea* is the famous "noble mold" of the Rhine and Sauterne wine districts. It is known as *Edelfäule* by the Germans, and as *Pourriture noble* by the French. As these names indicate, it is held in esteem and is considered beneficial to the wine. It appears about vintage time as a grayish-yellow, powdery mold upon the surface of the grape. Its main effect upon the grape is to soften and partially disintegrate the skin. This, in dry weather, allows a certain degree of evaporation and concentration of the juice of the grape. This is a very valuable result for countries where the grape ripens with difficulty, or where an especially heavy must is desired. In wet weather, however, this thinning of the skin is dangerous, as it allows the absorption of water and the growth of harmful molds which are liable to displace the *Botrytis*. According to Müller-Thurgau, after the *Botrytis* has penetrated the skin of the grape it lives more at the expense of the acids than of the sugar of the must. Thus, while the sugar is increased by the evaporation of water, the acid is decreased by the direct action of the mold. The mold also renders a part of the soluble albuminoids of the must insoluble, which results in a slower fermentation. The *Botrytis* is reputed to give a slight and agreeable bitterness to the wine of the grapes which it attacks. It gives none of the disagreeable "moldy" taste which is so characteristic of the commonest mold, *Penicillium glaucum*.

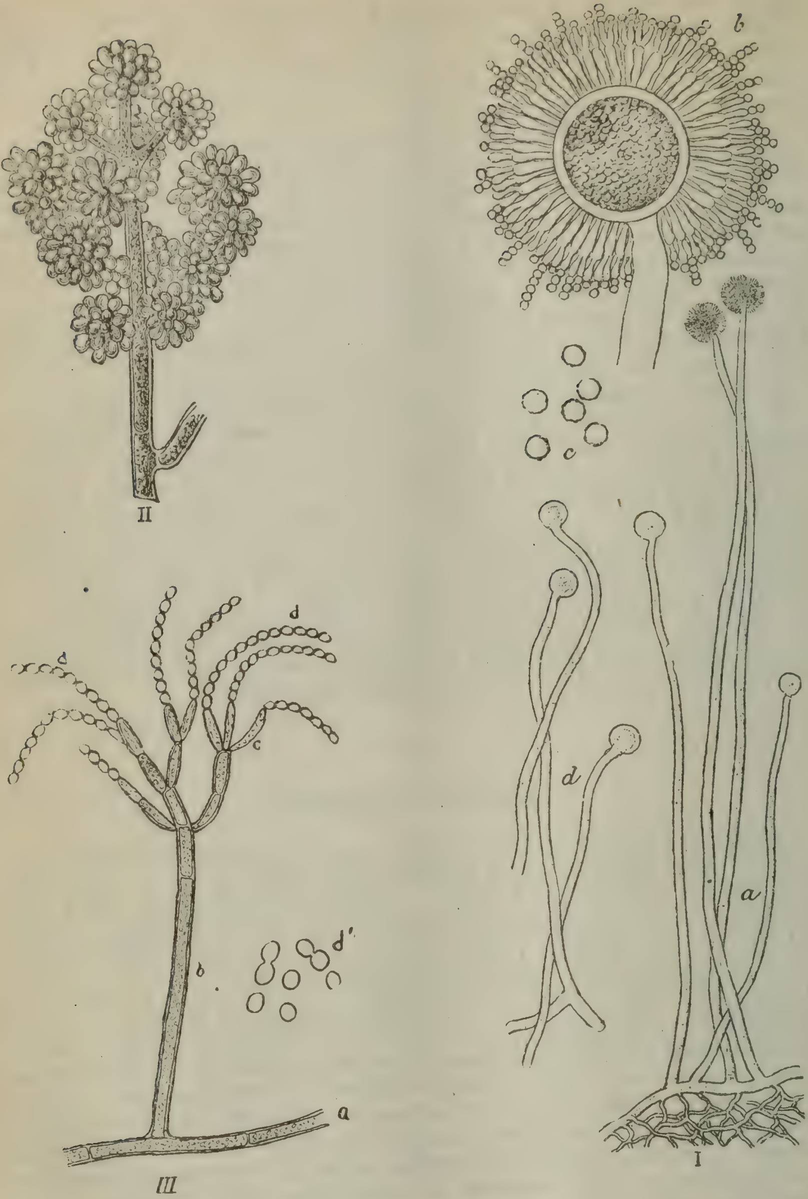

PLATE IV. GRAPE MOLDS.

I. *Aspergillus niger.* (After Duclaux.)
- *a.* Fruiting hyphæ.
- *b.* Sporocarp showing formation of spores.
- *c.* Spores enlarged.

II. *Botrytis cinerea.* (After Ravaz.)

III. *Penicillium glaucum.* (From skin of moldy grape.)
- *a.* Mycelium or vegetative part.
- *b.* Fruiting hypha.
- *d.* Chains of spores. *d'.* Spores enlarged.

The presence of *Botrytis cinerea* on California grapes was first noted by Mr. A. P. Hayne during the vintage of 1893. He found it very common at several vineyards in the neighborhood of St. Helena, Napa County, and later at Mountain View, Santa Clara County. It has also been noticed at Mission San José, Alameda County, and at Asti, Sonoma County. It probably occurs all over California whenever the conditions are favorable. As some careful wine-makers were rejecting the grapes attacked by this mold or relegating them to the distillery, several experiments were made to determine the kind and degree of action which the mold had on wine. The conclusion was that a small quantity of the mold had no appreciable effect, but that if the grapes were badly attacked the resulting wine was apt to have a Sherry taste, doubtless on account of the preliminary oxidation of the must through the partially disintegrated skin of the grape. As, on the contrary, other molds are well known to have a very injurious effect on the flavor of wine, it is important to distinguish between them and the *Botrytis;* therefore, a short description of *Botrytis cinerea*, of *Penicillium glaucum*, and of *Aspergillus niger*, the molds which are found most abundantly on grapes in California, will be useful.

The *Botrytis cinerea* is but a form of the *Sclerotinia Fuckeliana*, a fungus which is common on all parts of the vine. As it is the only form which at all affects wine-making, it is the only one described here. It appears on the surface of the ripe or nearly ripe grapes as a thick olive-gray layer. This layer consists of the mycelium or fungal threads covered with masses of spores. The microscopic view of the fungus may be seen in Fig. II. It will be noticed that the spores are in roundish bunches, and not joined together in chains as are those of *Penicillium.*

Penicillium glaucum is the common blue mold, found on almost all kinds of fruit which have been kept for a length of time in a damp place. In general, it can be distinguished from *Botrytis* by its bluish-green color and moldy odor. As may be seen by the microscopic view in Fig. III, the spores are in chains, which all have their origin at the ends of short branches springing from the end of a fruiting hypha or filament. This mold is seldom found in quantity on grapes before they are picked, except in rainy weather. It usually develops in the boxes and can be avoided by crushing the grapes as soon as possible after picking.

Aspergillus niger is the black mold which annually destroys tons of grapes in the warmer and irrigated portions of California. On account of its black color it cannot be mistaken for either of the above molds. Fig. I shows its microscopical characteristics. It attacks grapes which have closely packed bunches and tender skin. It is especially harmful to Zinfandel grown on irrigated land, and sometimes destroys the whole crop before it is ripe enough to gather. The best method of prevention is to adopt a method of pruning and training that will not permit the bunches of grapes to press against each other and which will allow a free circulation of air between them.

LIST OF VITICULTURAL PUBLICATIONS OF THE COLLEGE OF AGRICULTURE, AND OF ALL PUBLICATIONS OF THE LATE VITICULTURAL COMMISSION.

The publications of the University Experiment Station will be sent free to any address on application to the Director.

The large number of reports of the late Viticultural Commission, which were transferred to the Experiment Station by Act of the Legislature, can also be had on application, when accompanied by the necessary postage, as shown in the list given below. These State reports are not included in the class of Station publications allowed by Act of Congress to pass free through the mails. While the Viticultural Commission, with its annual appropriation of $15,000, could well afford to spare enough for postage on its reports, the Station cannot thus draw on the small sum of $2,500 given to the University to carry on the viticultural work.

REPORTS OF THE COLLEGE OF AGRICULTURE.

Date of Issue.	Title.	Postage.
1886	**Report of Viticultural Work during the Seasons of 1883-84 and 1884-85** *Contents :* Legislation concerning viticultural work. Statement of general objects and plan of work. Report of Committee of State Viticultural Convention of 1884. Wine Fermentation : The several fermentations; ferments. Circumstances that determine the several fermentations. Influence of temperature. The lacto-butyric, mucous, and mannite fermentations. The acetic fermentation. Conservation of wines. Points in the fermentation of red wines. Extract of report on "Studies on Wine Fermentation." Record of work in the viticultural laboratory for the season 1883-84. Tables showing proportions of pomace, must, etc., and composition of wines. Descriptive list of wine samples received 1883-84. Composition of Zinfandel wines. Record of work in the viticultural laboratory for the season 1884-85. Descriptive list of grapes received and wines made, with analyses of musts and wines. Descriptive list of wines sent for examination during season 1884-85. The vintage of 1885. University experimental plot at Cupertino. Record of work relating to the phylloxera. Mercury vapor as a remedy against the phylloxera. The phylloxera at Berkeley.	Free.
1886	**Report of Viticultural Work during the Seasons 1885 and 1886** *Contents:* General objects and plan of work. The new viticultural building. Collection of vine specimens. Colorimetric measurement of wines. Vintage and wines of 1885. Descriptive list of grapes, musts, and wines analyzed 1885-86. Condensed grape-must and its uses. Dr. Springmuehl's book on Italian wines.	Free.

REPORTS OF THE COLLEGE OF AGRICULTURE—Continued.

Date of Issue.	Title.	Postage.
1886	**Report of Viticultural Work during the Seasons 1885 and 1886**—*Cont.*	
	Descriptive list of wines received for examination and analysis in 1885.	
	Remarks on the vintage and work of 1886.	
	Descriptive list of grapes received and analyses of musts and wines.	
	Experiments on methods of fermentation.	
	The experimental vineyard at Cupertino.	
	Decrease and change of color after fermentation.	
	Vine mildew and its treatment.	
	Phylloxera-resistant vines.	
	Coulure of the vine.	
	A supposed vine disease in Los Angeles County.	
	The mercurial phylloxera remedy.	
1888	**Reports of Experiments on Methods of Fermentation and Related Subjects**	Free.
	Contents:	
	Composition of wines made by different modes of fermentation.	
	Fermentation under different conditions; effect of temperature.	
	Revival of fermentation.	
	Zinfandel fermentations.	
	Behavior of highly saccharine musts.	
	Extraction of color during fermentation.	
	Effect of climate on composition of musts.	
	Aëration.	
	Pasteurization of wines.	
	Red wine from condensed must by the Springmuehl process.	
1892	**Report of the Viticultural Work during the Seasons 1887–89**	Free.
	Contents:	
	Part I. Red-wine grapes.	
	General objects and plan of the viticultural work.	
	Colorimetric measurement of wine.	
	Viticultural stations under private auspices.	
	Descriptive list of grapes received, and of musts and wines analyzed 1887–89.	
	Pasteurization of wines.	
	Sterilization of wine by filtration.	
	Application of electricity in the aging and conservation of wines.	
	Use of ozone in aging and the conservation of wines.	
	The sweet-wine investigation.	
	Carpene's new methods of analysis of raw materials containing tartrates.	

PUBLICATIONS OF THE STATE VITICULTURAL COMMISSION.

Date of Issue.	Title.	Postage.	
		Bound.	Unbound.
1881	**Report of the Board of State Viticultural Commissioners for 1881**	----------	6 cents.
1881	**Report of the Board of State Viticultural Commissioners for 1881.** Second edition; revised	----------	5 cents.
	Contents:		
	Acts of the Legislature.		
	Reports of President, Officers, and Members of the Board.		
	Diseases of vines.		
	Raisin-making in Spain.		
	Wild vines of California and Arizona.		
	Seedlings.		
	Vine of the Soudan.		
	California wines.		
	Permanent maintenance of our vineyards.		
	Appendix A–H, J. Phylloxera and its treatment.		
	Appendix I. Grafting American vines.		
	Sessions of the Board.		

Publications of the State Viticultural Commission—Continued.

Date of Issue.	Title.	Postage.	
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1882	**Report of the Chief Viticultural Officer for 1881** *Contents:* Phylloxera; Resistant vines; Grafting. Appendix A. Reconstruction of southern vineyards. (Foëx.) Appendix B. Wild vines of America. (Millardet.) Appendix C. Carbon bisulphide and sulpho-carbonates. Appendix D. Report of Committee on Vine Pests.	8 cents.	6 cents.
1884	**Report of the Chief Viticultural Officer for 1882–84** *Contents:* Part 1. Original investigations. Part 2. Viticultural industry in California. Part 3. Culture of the vine in California. Part 4. Ampelography. Part 5. Pruning, training, and maintenance of the vine. Part 6. Diseases and pests. Part 7. Miscellaneous.		5 cents.
1888	**Report of Board of Viticultural Commissioners for 1887** *Contents:* Report of President of the Board. Index to some reports of Board. Statistics of exports of wines and brandies. Reports of Commissioners. Report of Secretary of Board. Catalogue of books in Viticultural Library. Report of Chief Viticultural Officer. *Oidium Tuckeri*, and the use of sulphur. The pure-wine bill. Bleaching Seedless Sultana raisins. How to avoid and correct imperfect fermentation. Vineyards in the south of France. Treatment of wine by electricity. Herbaceous grafting. Report of the State Analyst. Arsenic remedy for grasshoppers.	6 cents.	4 cents.
1888	**Report of the Sixth Annual Convention** *Contents:* Raisin-making; Table and shipping grapes. Resistant vines and grafting. Vine pests and remedies. Chaintre system of pruning in California. Wine cellars for interior valleys. Wine-making machinery and cellar construction. Wine and brandy-making as a profession. Electro-magnetism for aging wine. Sherry flavors in wine. Fermentations at Viticultural Laboratory. Distillation of grape brandy. Temperance reform. Fermentation and California wines. Sophistication of wines. Our markets for wine, and wine-storage. How to drink wine: wine as a temperance agent.	7 cents.	5 cents.
1889	**Wines.** By R. Boireau; translated by E. A. Schneider *Contents:* A short treatise on vinification. Care and treatment of wines in cellar and store.	6 cents.	4 cents.
1890	**Report of the Board of State Viticultural Commissioners for 1889-90** *Contents:* Report of President and officers. Report of E. Dowlen on Anaheim disease. Raisins. Resistant vines in Sonoma. Tariff and sweet-wine bill.	9 cents.	7 cents.

PUBLICATIONS OF THE STATE VITICULTURAL COMMISSION—Continued.

Date of Issue.	Title.	Postage.	
		Bound.	Unbound.
1890	**Report of the Board of State Viticultural Commissioners for 1889-90**—*Continued.* Appendix: Resistant vines. California grape-hopper. Destruction of animal and vegetable parasites. Grafting Muscats. Wines. By R. Boireau; translated by E. A. Schneider. A short treatise on vinification. Care and treatment of wine in cellar and store. Import duties of various countries.		
1891	**How to raise the price of grapes, and an analysis of the sweet-wine law**		1 cent.
1891	**Report of George West for 1891**		1 cent.
1891	**Directory of the grape-growers, wine-makers, and distillers**		6 cents.
1892	**Report of the Board of State Viticultural Commissioners for 1891-92** *Contents:* Reports of officers of the Board. Appendix B. Transactions of the Eighth Viticultural Convention. Appendix C. Utilization of wine residues, by A. Dal Piax. Appendix D. Import duties of various countries. Appendix E. Wine: Classification, tasting, qualities, and defects. By G. Grazzi-Soncini. Resistant vines.	9 cents.	7 cents.
1892	**Wines: Classification, wine-tasting, qualities, and defects.** By G. Grazzi-Soncini; translated by F. T. Bioletti	5 cents.	
1892	**Appendix A to Report for 1891-92. Brandy distillation**	6 cents.	4 cents.
1892	**The vine in Southern California**		1 cent.
1893	**The vineyards of Southern California**	4 cents.	2 cents.
1893	**The vineyards of Alameda County**	4 cents.	1 cent.
1893	**Grape syrup**	4 cents.	2 cents.
1894	**Report of the Board of State Viticultural Commissioners for 1893-94** *Contents:* Reports of Officers and Commissioners. Amended sweet-wine law. Appendix C. Midwinter Fair display. Appendix D. Phylloxera of the vine. By V. Mayet. Appendix E. Possible trade in Mexico. Appendix F. Tariff of various countries.		5 cents.
1894	**Treatise on Wine Production** *Contents:* Part 1. Types of European vintages. Conditions affecting the quality of California wines. Part 2. California wines at the World's Columbian Exposition. Part 3. Tariff and internal revenue taxes. Part 4. Chemical analyses of California wines.		4 cents.

Of some of the early reports of the Viticultural Commission the supply is so nearly exhausted that they cannot be offered for general distribution, and hence are not included in the enumeration.

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The page on which will be found the special description of each variety of grape, together with the analyses of its musts and wines, and the records of treatment and tasting during vinification, is given in full-face type.

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UNIVERSITY OF CALIFORNIA—COLLEGE OF AGRICULTURE.

AGRICULTURAL EXPERIMENT STATION.

REPORT OF WORK

OF THE

AGRICULTURAL EXPERIMENT STATIONS

OF THE

UNIVERSITY OF CALIFORNIA,

FOR THE YEAR 1894-95.

BEING A PART OF THE REPORT OF THE REGENTS OF THE UNIVERSITY.

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REPORT

OF THE

Professor of Agriculture and Director of the Experiment Stations

TO THE

PRESIDENT OF THE UNIVERSITY.

E. W. HILGARD, Director.

SPECIAL NOTICE TO PERSONS SENDING SAMPLES FOR EXAMINATION TO THE EXPERIMENT STATION.

1. The work of the Station being designed for the benefit of the agricultural public, we do not undertake to investigate matters of purely private interest, unless conclusions subserving the public interest can be drawn therefrom. The Station does not undertake to solve riddles for the merely curious. It should, however, be understood that the examination of soils, waters, insects, plants, and other natural or new materials of interest to the agriculturist forms part of the general plan of investigation of the resources of the State. So far, therefore, as any such examination fills a gap in our knowledge of the State, it will fall within our province, even though for the moment benefiting only an individual. Special directions for the proper taking of soils and waters will be sent on application.

2. In order to insure attention and examination, every sample sent must be accompanied by a full statement of the origin, mode of occurrence, or special nature of the object sent, with a mention of the particular points upon which information is desired, and the object in view in asking the question. Without such information the Station would, in many cases, have to go to an amount of trouble quite disproportionate to the value or importance of the object to be obtained, nor would the public interest be subserved.

3. Every package sent should always be distinctly marked with the sender's name and post office, even when a letter is inclosed in it. Whether sent by mail or express, all packages must be *prepaid by the sender*, unless sent by special request of the Station.

4. Reports of such examinations will be sent by letter, when completed, and the results will be published in the ensuing annual report of the Station. The annual reports and bulletins will be mailed free to any resident of the State requesting the same.

Remember that your package is but one of many that may arrive on the same day, and that our staff cannot afford to spend their time in comparing and identifying the handwriting on letters and packages; also, that for the same reason immediate action upon the sample cannot be expected, but that you must take your turn among the rest. If, for particular reasons, an immediate answer is desired, state the fact and the reasons therefor, and, so far as possible, examination will be expedited.

The Station publications will be sent to any citizen of the State on application.

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EXPERIMENT STATIONS OF THE UNIVERSITY OF CALIFORNIA,

1894-95.

CENTRAL STATION (Berkeley, Alameda County).

E. W. Hilgard, Ph.D., LL.D. (Professor of Agriculture), Director and Chemist.
E. J. Wickson, M.A. (Associate Professor of Agriculture, Horticulture, and Entomology), Superintendent of Agricultural Grounds.
E. L. Greene, Ph.B. (Associate Professor of Botany), Botanist (resigned).
R. H. Loughridge, Ph.D. (Assistant Professor), Agricultural Geologist and Agricultural Chemist.
C. W. Woodworth, M.S. (Assistant Professor), Entomologist.
W. A. Setchell, Ph.D. (Professor of Botany), Botanist.
M. E. Jaffa, Ph.B. (Instructor), First Assistant Chemist in Agricultural Laboratory.
Arthur P. Hayne, Ph.B. (Instructor), Assistant in charge of Viticulture and Olive Culture.
Geo. E. Colby, Ph.B. (Instructor), Second Assistant Chemist in Viticultural Laboratory.
C. H. Shinn, A.B., Inspector of Stations.
Emil Kellner, Foreman of Station Grounds.
F. T. Bioletti, B.S., Foreman of Viticultural Cellar.
A. V. Stubenrauch, Clerk to the Director.

SIERRA FOOTHILL CULTURE STATION (near Jackson, Amador County).

R. C. Rust, Patron; Jackson.
George Hansen, Foreman; Jackson.

SOUTHERN COAST RANGE CULTURE STATION (near Paso de Robles, San Luis Obispo County).

R. W. Putnam, Patron; Paso Robles.
W. H. Tyson, Foreman; Paso Robles (resigned).

SAN JOAQUIN VALLEY CULTURE STATION (near Tulare City, Tulare County).

A. J. Pillsbury, Patron; Tulare City.
Julius Forrer, Foreman; Tulare City.

SOUTHERN CALIFORNIA CULTURE STATION (near Pomona, Los Angeles County).

Richard Gird, Patron; Chino (resigned June, 1895).
J. H. Lee, Patron; Chino (appointed June, 1895).
J. W. Mills, Foreman; Pomona.

CHICO FORESTRY STATION (near Chico, Butte County).

R. F. Pennell, Patron; Chico.
A. B. Boland, Foreman; Chico.

SANTA MONICA FORESTRY STATION (near Santa Monica, Los Angeles County).

H. J. Kruckeberg, Patron; Santa Monica.
Wm. J. Strachan, Foreman; Santa Monica.

VITICULTURAL STATION (under private auspices).

East Side Santa Clara Valley Station; Mission San José, Alameda County. John Gallegos, Patron; Mission San José.

COURSES IN AGRICULTURE AT THE UNIVERSITY OF CALIFORNIA.*

Agricultural Chemistry—

1. *General Course.* (*a*) Chemistry and Physics of Plants, three times a week during the first term. (*b*) Soils and Theory of Culture, three times a week during the second term. Professor Hilgard and Assistant Professor Loughridge.

2. *Vinification.* Lectures twice a week during the first term, with practical cellar-work. Mr. Hayne and Mr. Bioletti.

3. *Agricultural and Viticultural Laboratory.* Twelve to fifteen hours a week during both terms. Mr. Jaffa and Mr. Colby.

3a. *Analyses of Forage Plants, Hays, etc.* Lecture once a week and six hours laboratory during second term. Mr. Jaffa.

Agriculture and Horticulture—

4. *General Course.* Three times a week during both terms. Associate Professor Wickson.

5. *Viticulture and Olive Culture.* Twice a week during the second term. Mr. Hayne.

6. *Special Courses* given as called for.

Entomology—

7. *Elementary and Economic Entomology.* (*a*) Lectures and laboratory work, twice a week during the first term. (*b*) Supplementary laboratory work, once a week during the first term. Assistant Professor Woodworth.

8. *Apiculture.* (*a*) Lectures, laboratory and apiary work, twice a week during the second term. (*b*) Supplementary laboratory and apiary work, once a week during the second term. Assistant Professor Woodworth.

9. *Parasitic Plant Diseases.* Lectures twice a week during the first term. Assistant Professor Woodworth.

10. *Systematic Entomology.* Lectures three times a week during the second term. Assistant Professor Woodworth.

11. *Structural Entomology.* Lectures three times a week during second term. Courses 10 and 11 are given in alternate years. Assistant Professor Woodworth.

12. *Entomological Laboratory.* Two or three times a week throughout the year. This course can only be taken with or after Courses 9, 10, or 11. Assistant Professor Woodworth.

Agricultural Seminary—

13. Elementary course for study of current agricultural literature, once a week during both terms. Associate Professor Wickson and other instructors.

Practical Work at Cellars and Vineyards—

Students who have taken the course in viticulture can avail themselves of arrangements made with the best wine-makers and merchants for special opportunities to pursue, under the auspices of the University, such lines of work as will familiarize them with vinification and viticulture as practiced at large establishments in the city or country. Students showing special aptitude are enabled to earn good wages from the first; others merely work for their board. After working under University auspices at one or more establishments they are assisted in the pursuit of further information at the viticultural laboratory as opportunity offers.

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*In addition to the general requirements in mathematics, literature, languages, and general sciences; for detailed description of which see the General University Register.

LETTER OF TRANSMITTAL.

President Martin Kellogg:

Dear Sir: I transmit herewith the report of the Experiment Station work since the issuance of the last report, in which the results obtained at the Station laboratory up to July 1, 1894, were included. The present report embraces the same work up to July, 1895, and the culture reports of the several sub-stations up to the close of the season of 1895. The unusually heavy pressure of current work has prevented the earlier completion of the manuscript.

As the public interest and demand for work increase, the cumulative duties of instruction and experimental work, in which almost the entire staff participates, are rapidly becoming too heavy for the present force, which even now is almost wholly deprived of vacations. The agricultural laboratory now usually has the full complement of students that can be accommodated, and as their work is not of a routine character, but special for each one, and therefore requiring individual supervision, the most urgent need is for an additional chemist to aid the laboratory assistants in keeping even with the public demand, and to enable them to pursue with some degree of continuity the research work, which it is the main province of experiment stations to conduct. Fortunately the advanced laboratory students are frequently qualified to take part, and have, during the past year, especially, rendered important aid in the carrying out of special work; which, having the character of original investigation, increases their interest and diligence to a marked degree. The advantage of combining experimental work and instruction, to which I have often referred, is thus constantly and strikingly exemplified. The fundamental principle of the kindergarten, viz., to enlist the learner's interest by the performance of work that gives scope to the development of original ideas, holds good equally in later life.

We also note as an encouraging feature the increasing attendance of graduate students upon both lecture and laboratory courses. Also, that while students entering the agricultural course very rarely change to another one, the reverse change is becoming more and more frequent, notwithstanding the much deplored "agricultural depression." The overcrowding of the professions of law and medicine, as well as of the literary ranks, is gradually making itself felt, so as to induce parents to hesitate before adding their sons to the army of the educated unemployed; and as it becomes more and more obvious that under present conditions the best success in agriculture requires quite as much intelligence and brain work as do the other professions, it is probable that the indisposition of young men to engage in agriculture will steadily diminish. The fact that uninstructive labor has been abolished as a part of the general course, in all but one or two of the agricultural colleges of the United States, bears in the same direction.

The direct connection between experimental work and instruction has, during the last two years, been strongly accentuated here, both by the successful establishment, by Professor Wickson, of a "Seminary Course," in which all the members of the staff have alternately taken part; it has for its special object the study and discussion of the bulletins and reports of experiment station work, by the students taking part in the course, and is open to all students of the University desiring to participate in it. A number of students from other colleges take this optionally, as their only course in agriculture.

The students are thus made acquainted with the results of the latest investigations, and with the burning questions of the day upon which they bear. At the same time the discussions serve to familiarize the members of the staff with the methods and difficulties connected with those wider seminaries among the agricultural population itself, which are developing more and more in the form of Farmers' Institutes and other periodic assemblages, in which the life topics of direct interest to local communities are discussed off-hand, and largely without any previous opportunity for special preparation. A more detailed statement regarding these Institutes is given farther on; but it is proper to accentuate, in this place, the fact that they serve not only as the most effectual mode of rendering the results of experiment station work directly available to the population interested, but also to obtain for that work most valuable suggestions as to the direction in which energy may be most usefully employed, to supply the demand for information on topics of practical interest in a new country.

Contrary to the policy defined and pursued by many European stations and by a few in the United States, I hold, and have always held, that it is the first duty of our stations, more especially in the newer States, to minister to the pressing needs of farmers on matters and questions of practice, on which their own previous experience, and in very many cases the existing literature, furnish them little or no useful information, and which, therefore, they would have to determine for themselves by blind and costly experimenting, not infrequently involving financial ruin. The allegation that such work is not the proper province of the stations, is completely and overwhelmingly overthrown by the fact that the investigations of such questions will almost invariably lead to the development of new facts and principles, or, to modifications of admitted principles; which is acknowledged on all hands to be one of the main objects for which the stations were established, since it is out of the power of the farming population to deduce and apply them for themselves. It is hardly too much to say, that this method of study is the main *raison d'être* of the Experiment Stations in the newer States, and that upon any other basis the passage of the Hatch Experiment Station bill through Congress would have been impossible.

Examples of Results.—I think the contents of the present report illustrate and emphasize the above statement very strikingly. To exemplify: The investigation of the alkali lands of California, which has been steadily continued since the question was opened up by me in 1880, has now advanced to such definite results that the "hushing-up" policy, so long pursued by owners of such land, has been replaced by active efforts toward the reclamation, whether by the culture of plants especially adapted to them, or by such other modes of treatment (e. g., the use of gypsum to neutralize "black alkali") as will fit them for the production of ordinary crops. Coupled with these practical results is a number of theoretical deductions of high and wide interest, as is more fully shown in the corresponding portion of the present report. Had the demand for information on these lands been met with the same indifference which it has, until recently, encountered in the older portions of the world, the taboo heretofore resting upon these lands on the Pacific Slope would still continue.

The successful introduction of the Australian saltbushes as a result of the experiments made at the *San Joaquin Valley Station*, under the intelligent and efficient management of Foreman Forrer, has attracted wide attention, not only in this State and in the arid region of the United States generally, but also in the Old World, including Russia, Egypt, and Algeria; and the seed produced at the Tulare Station has enabled us to obtain by exchange with European or Eastern seedsmen valuable collections of seeds, which the limitation of our funds would otherwise have prevented us from acquiring. We will be able to avail ourselves of this source of income (to which such exchanges are equivalent) for at least one more year, besides supplying the current demand in California, and the stations and private experimenters of the arid and semi-arid region. Other species, still under trial, may prolong these advantages through several years. As heretofore stated, our policy is and has been to cease our gratuitous distributions of seeds so soon as they have become an article of general trade; so as not to compete with the legitimate business of seedsmen. It is to be hoped that the adoption of this policy by the U. S. Department of Agriculture, so earnestly advocated by Secretary Morton, will not be overborne by the opposition that has manifested itself in Congress, tending to reëstablish the uncalled-for distribution of ordinary garden and field seeds by the Government.

Next to the San Joaquin Valley Station, the *Southern California Station*, between Pomona and Chino, has attracted wide attention by the demonstration of the extent to which *sugar beets* of high quality can be grown on land more or less impregnated with alkali salts. These results have excited surprise and interest on both sides of the Atlantic, because of their apparent contradiction of long-established rules of practice in European countries where the beet-sugar industry flourishes, and where the presence of such amounts of salts, whether naturally existing or added in the form of fertilizers, has been considered a definite bar to high sugar-making qualities in the beet root. We are even yet in doubt whether this discrepancy of results is due solely to the different quality of the salts themselves, or in part, at least, to climatic influences. But there can be no question about the facts themselves, or as to the possibility of using successfully, in the culture of the sugar beet, large areas of land impregnated with the alkali salts to an extent sufficient to render the culture of many other crops altogether unprofitable. Experiments to test the adaptability of the *cañaigre root* to similar lands are now in progress.

It is but fair to mention that this line of experimentation is materially facilitated by the training which Mr. Mills, the present foreman of the Southern California Station, has received during a two-years' course at the University, and which enables him not only to carry out most intelligently the somewhat complicated experiments required in the premises, but also to make personally many of the chemical and other tests, without the delay and expense incident to their reference to the Central Station at Berkeley. There can be no doubt that in the future it should be our policy to give preference to men possessing such training, in making appointments to the foremanships.

The *Southern Coast Range Station*, near Paso Robles, has in the past suffered from the lack of such training on the part of its foremen, and it has been thought worth while to delay for some time the filling of a vacancy caused by the resignation of the former incumbent, in order to afford further opportunity for practical and other studies to the new foreman, Mr. A. V. Stubenrauch, who, in the course of several years study in the University, and service in the Director's office at Berkeley, has become thoroughly acquainted with the objects and methods of Station work. It is in these widely important points that gardeners and other "practical" men are usually so deficient as to be continually overlooking important details, without the observance of which experiments lose their cogency and value. Yet even thus the work at that Station has shown some very important and rather surprising results; notably the fact, that notwithstanding its southern location, and at a very moderate elevation above sea-level, the extreme variations of temperature to which that region is liable necessitate the use of the more hardy varieties of fruit, with which those originally planted are now being replaced, in consequence of the poor results obtained with many supposed to be adapted to that latitude. Such negative results are, of course, fully as important as those showing marked successes, as they will prevent farmers from making losing investments in planting varieties unadapted to the climatic conditions. As a consequence of these needed replacements and additions, it is now becoming painfully apparent that the measure of land supposed to be sufficient for experimental culture, viz., twenty acres, is quite insufficient, and should if possible be increased by at least 50 per cent. We are now renting an adjacent tract on account of this inadequacy.

The *Foothill Station*, in Amador County, while quite successful in the culture of a great variety of fruits, is still suffering under the disadvantage of isolation, consequent upon the still undiminished distance of seventeen miles from the railroad terminus. Had it not been confidently expected that the town of Jackson, not quite five miles from the station, would within a few years be reached by the railroad, the Foothill Station should never have been established at its present location, however advantageous from other points of view, and as a remarkably representative locality. The difficulty of communication diminishes materially the value of the Station, since not only is it rarely visited by the fruit farmers interested in its work and results, but it also renders difficult and expensive the transmission of supplies, as well as that of its products to the Central Station. The rough roads and great heat prevailing at the time of the fruit harvest, rarely permit samples of any size to arrive in fair condition; so that if the Station is to be maintained in its present locality (and removal would mean the adandonment of an enormous amount of valuable material and virtual results), it will become necessary to arrange more effectually for the performance, on the spot, of a certain kind and amount of work, which, in the case of the other culture stations, is done at the Central laboratory at Berkeley. Conditions somewhat analogous to those referred to as existing at the Southern Coast Range Station, will also necessitate the material increase of the number of varieties, especially of the hardier fruits; and this again will require an enlargement of the present area of the Station land in the near future. It is probable that this enlargement can be obtained without the cost of purchase.

Suggestions for the establishment of a branch station on or near the line of the Central Pacific Railroad, in the great fruit-producing region near Newcastle and Auburn, have been repeatedly received, but have not assumed so definite a shape as to justify present consideration. It is undoubtedly to be greatly regretted that similar suggestions did not assume a tangible shape at the time when, after the passage of the Hatch Bill, the selection of sites for the culture stations was under public discussion. The present Station foreman, Mr. Hansen, has been most energetic in the improvement of the Station domain from the outset, and has, in addition, made important studies and contributions to the botanical knowledge of the Sierra slope, in collaboration with the Department of Botany at the University.

The two *Forestry Stations*, at *Chico*, and at *Santa Monica*, respectively, have made good progress under the extremely limited appropriations given by the Legislature, which necessarily render their development slow, and in a measure unsatisfactory. We are fortunate, however, in having, notwithstanding the extremely low salary compatible with the maintenance of the Station work, secured very efficient and intelligent foremen at both stations—men whose interest in the work intrusted to them outweighs mere pecuniary considerations. I trust that these extreme and almost crippling financial limitations may be removed at the next session of the Legislature. In the meantime, a liberal interpretation of general experimental work must enable us to relieve, to a certain extent, the most pressing needs of the forestry work, by such assistance from other sources as the constantly increasing demands upon our other funds will permit.

The system of exchange, already referred to, enables us to increase the stock and number of desirable species of trees at very slight expense. The confusion of nomenclature which we found existing at Santa Monica, when the station was transferred to us, is being gradually rectified, especially as regards the eucalyptus, by comparison with standard collections, but requires time and the services of experts. In this, and all other work, the limited financial resources interpose serious obstacles, which have sometimes been taken advantage of for unjust criticism. From the same cause it has been impossible, thus far, to establish the highly desirable forestry station on Mount Hamilton, which, from the general point of view, is specially important as representative of a large area of lands within the Coast Range belt that cannot, for a long time, if ever, be utilized for agricultural purposes. The valley and plateau lands on which the two forestry stations at present existing are located, are certain to be in a future, not far distant, too valuable to be occupied for forestry purposes. The experiments made at Berkeley have proven that there is no difficulty in foresting the lower Coast Ranges; it remains to be shown how the higher ridges can be most advantageously utilized in the growth of useful trees.

The management of all the culture stations has, as heretofore, been in the hands of Inspector C. H. Shinn, to whose interest and intelligent zeal in his work much of the success is due. The duty of apportioning and coördinating both the financial and executive portions of the work at so many points is not a light nor easy one, and becomes unpleasantly arduous unless seconded by intelligent foremen, who enter into the spirit of the work and know how to maintain the proper relations toward the public. Among the difficulties encountered in the latter respect is the impression existing in the minds of many visitors that, inasmuch as the stations are maintained at public expense, the public (represented by themselves) may freely help themselves to whatever plants they may fancy without saying "by your leave." This trouble is also not unknown at the Central Station at Berkeley, and is by no means confined to the uneducated. But as it is neither feasible nor desirable to exclude the public by impervious inclosures, and constant guarding is too expensive, the only remedy appears to be that of moral suasion, by enlightening the public on the subject, and appealing to the good sense and public spirit of visitors. A few flagrant cases have had to be dealt with more severely, and several newspaper attacks upon the department are traceable to this cause.

At the *Central Station*, at Berkeley, the culture work has participated in the general suffering from financial stress; the funds at command have not been sufficient to occupy the entire ground, and we have been obliged to rest content with the propagation of our cereal and other collections on a very small scale, in order not to lose the seed, but without obtaining enough for distribution. The stringency has been materially increased by the extra work unavoidably connected with the construction of the new plant-house, the contract price for which proved insufficient for the completion of the outside (and of much of the inside) work, which had thus to be done, so far as essential to the use of the conservatory, by the regular force of the department. The surroundings still remain in a very incomplete, unsightly, and inconvenient condition; but aside from this, the new building has proved extremely satisfactory for the actual needs of the work, enabling us, for the first time, to supply properly the needs of instruction in the Agricultural and Botanical Departments, and to propagate with certainty and success the new and valuable seeds and plants constantly obtained by exchange or purchase, which under former conditions have been partially or wholly lost within a few seasons in consequence of the inadequacy of the old and badly delapidated houses. The latter can still for some years be made to serve useful purposes in connection with the less delicate cultures, and as a needed shelter for tools and implements.

The crowd of visitors to the *New Conservatory*, even in the present inchoate condition of the collections, gives gratifying assurance of the increasing public interest, and has rendered it necessary, or at least expedient, to keep the building open to visitors even on holidays—the only time at which the working and commercial classes can avail themselves of the privilege. The increase of service thus required, together with the cost of heating so large a building, adds not immaterially to the current expenses; so that an increased permanent charge is thus imposed upon the department, which must still further restrict the cultural experimental work, unless its resources are increased.

The *Garden of Economic Plants* continues its increasing usefulness as a source of seeds and plants grown for distribution both to the outlying stations and to the general public. It has become necessary to transfer to other portions of the grounds some of the plantations intended to grow seeds for distribution on a larger scale; and its present decrepit fence will require both enlargement and renewal for the more effectual protection of the plantings, from small and even adult depredators, whom, under our present arrangements, it is impossible to keep in check effectually. It has even become necessary to avoid labeling valuable plants with their proper names, to prevent their being bodily taken up and carried off.

Laboratory Work.—As regards laboratory work, some general statements have already been made above, showing the pressing outside demand and high pressure under which this work is carried on. In the past, considerable attention and time have been given to the investigation of the *waters* of the State, the bearing of which upon the settlement and prosperity of large sections is all-important, since waters unfit for domestic use or irrigation are not uncommonly found, causing loss, both of health, labor, and money. It is proposed to continue this work, so far as irrigation waters are concerned, but, in view of the excessive demands that absorb too much precious time for work of but limited public interest, to restrict materially all other examinations of waters; the more as the work already done has given us a very fair acquaintance with the character of the waters in nearly all the settled districts of the State.

The same policy must be pursued with reference to the *analysis of fertilizers*, so frequently called for that to comply with the demand must soon swamp our regular work. In exceptional cases, when a new article is being put upon the market, it may be properly considered the province of the Station to enlighten the public in regard to its merit. But anything like control of manufactured fertilizers sold in this State is out of the question with our present resources, and it would be useless to attempt it in the absence of an effective fertilizer-control law. That such a law, with effective provisions for its enforcement, is extremely desirable, not to say necessary, in the interest of farmers, hardly admits of question; the experience of nearly all the other States is conclusive on this point. But it is not in the interest of this Station to be burdened with the purely perfunctory work of fertilizer-control, and it does not seek the charge, although willing to undertake it should the farmers so desire, and should the Legislature provide adequate means for the purpose. Any movement to that effect must, however, proceed from the agricultural public.

Viticulture and Olive Culture.—The study of the subject of *viticulture* has, during the past years, been pursued upon substantially the same plan outlined in former reports; but it has been thought best to reserve publication of results for a special report, to serve as a complement to the one last issued (a summary of the work done on red-wine grapes), by embracing the subject of white-wine grapes, together with other studies since carried out. In view of the depression of the viticultural interest, this publication has been purposely delayed, as it would have excited little interest with the discouraged grape-growers. Now that the wine industry is showing signs of revival, and more especially since the work of the Viticultural Commission has ceased and has partially devolved upon us, the report of the work done since 1892 will be sent to the press shortly after the present one. The invasion by the phylloxera of numerous districts heretofore considered exempt, has aroused the interest of the grape-growers in the maintenance or reconstitution of their vineyards on resistant stocks; and Mr. Hayne has complied with numerous requests for personal visits and public lectures on that and other viticultural subjects. The appropriation for such work made by the last Legislature, although much delayed in becoming available, now enables us for the first time to go out among the population interested in the subject, and to make our work felt. More detailed statements are reserved for the forthcoming viticultural report. Assistant Hayne has been taxed to the utmost by the correspondence, the instruction and experimental work in the two branches under his charge. In this he has been ably seconded by Mr. Bioletti, who, in his absence, has taken charge of both class and experimental work, and has made himself specially proficient in the investigation of both bacterial and fermentative diseases of the vine and of its products, as well as in all that relates to the botanical side of the work.

Mr. Hayne has been specially active in the study of *olive culture*, this subject having engrossed a large portion of his time, both on account of the active correspondence involved and the numerous specimens sent in by producers for examination or identification. The lively interest and demand for information rendered it expedient to publish a separate advance edition (1,000 copies) of the portion of this report relating to olive culture, which therefore appears as an independent appendix to this volume. The separate edition was exhausted within six weeks after its issuance, and the demand still continues. With the rapid increase of the area of olive culture in this State, the importance of this work is correspondingly enhanced, for the numerous analyses by Assistant Colby show clearly that this industry is even more dependent upon the intelligent selection of varieties adapted to particular localities than is that of grape-growing and wine-making; the enormous differences shown in the oil contents alone being sufficient to throw the balance for profit or loss, even aside from the quality of the oil. It is notable that no researches of this scope have ever been undertaken in the Old World, where the varieties grown are such as have been handed down from father to son in each locality; and our results will therefore command attention, even where this ancient industry has been practiced from time immemorial.

Work of Laboratory Assistants.—In addition to the very exacting work on olives, just referred to, Mr. Colby has carried out the usual large complement of analyses of musts, wines, fruits, cañaigre, etc., which will be found recorded in their proper places, and have added materially to the general knowledge of some portions of this interesting subject.

Mr. Jaffa, in addition to his duties as instructor in the laboratory and as lecture assistant, has, as heretofore, performed a large amount of miscellaneous work on specimens of all kinds, including numerous samples of sugar beets, sent for examination, while steadily continuing certain lines of special research, notably the study of the nitrogen-contents of soil and humus, and the composition of cattle and human foods, having prepared and delivered several lectures on the latter subject, both in the seminary course and on public occasions, including farmers' meetings.

The *Farmers' Institute work*, the immediate supervision of which is entrusted to Professor Wickson, has of late commanded much deeper interest; and it has fully exhausted available funds to even partially satisfy the public demand. I regret to state that this interest has not been evenly distributed geographically, for there has been a measure of apathy in the northern and central parts of the State, contrasting with the almost intense eagerness south of the Tehachapi Mountains. According to the plan approved by the Regents of the University upon the inception of the work, the Institute effort has been directed to those points where greatest interest was manifested and widest coöperation was possible. During 1894 and 1895 these points were clearly in Southern California, and to specially minister to and to promote this interest, Professor A. J. Cook, of Pomona College, Claremont, Los Angeles County, was, at my request, designated by the Regents as University Representative in Farmers' Institute work in Southern California. Professor Cook was formerly connected with the Michigan Agricultural College, and has been a prominent Institute speaker in the East. His acquaintance with Institute methods, his zeal and success as an organizer, and his acceptability as a speaker, have exerted a marked influence in the extension of interest in the south.

Since the publication of the last report, Farmers' Institutes have been held under University auspices as follows:

1894—	March	Visalia.
	July	Monrovia.
	September	Santa Barbara.
	December	Redlands.
1895—	March	Tulare, Riverside, and Perris.
	July	San Diego, Escondido, and Santa Ana.
	September	Nordhoff, Ventura, and Santa Paula.
	December	Lancaster, Glendale, and Clearwater.

These meetings have, as a rule, been very satisfactory both in manifestation of interest and in attendance. At nearly all of them there have been two University representatives present, who have delivered stated lectures upon subjects of local importance, and the localities have furnished groups of excellent speakers upon pertinent agricultural and educational topics. In most cases the sessions have been enlivened with good music, both vocal and instrumental.

The plan of arrangement, which according to our recent experience seems most commendable, is to select three central points in the same general region of country, and to give two days to each of these points. The proceedings open with the afternoon session of the first, and close with the evening session of the second day—thus giving five-session institutes at each place. By this plan, in one week we are able to hold three institutes in different localities, and thus reach the greatest number of people with a minimum of cost of travel and of absence from regular work at Berkeley.

In addition to the regular Farmers' Institute work, the staff of the Station has done much in the same line, though under a different name. At Camp Roache, a summer school of agriculture in the Santa Cruz Mountains, under the auspices of the State Grange, four lecturers from the State University participated. At conventions and local meetings of fruit-growers, viticulturists, and dairymen, chiefly in the central region of the State, the Station staff has taken an active part, and demonstrations of Station work in various lines have been made. We cherish a genuine interest in all these undertakings, which are clearly in the line of advancing agricultural intelligence; and though the undertaking often seems a heavy addition to the weight of our stated duties, we gladly embrace the opportunity to popularize the aims and accomplishments of the Station, and to reciprocate the interest manifested in this branch of the University work, which is clearly growing in all parts of the State, and in all lines of agricultural effort.

In addition to the Farmers' Institute work, and his usual lecture courses, Professor Wickson, while, as usual, superintending the work on the experimental grounds at the University, has rendered active aid in supervising the construction of portions of the new plant-house. Much credit is due in the latter connection to Foreman Emil Kellner, whose energy and thorough knowledge of detailed requirements of construction, and good taste in carrying out the improvements of the surroundings, have been of great service.

Professor Loughridge has, during the past year, divided his time between editorial work on bulletins and reports, the examination and reporting of specimens of soils, rocks, etc., currently sent in, and the systematic pursuit of the investigation of the alkali question; the important and definite conclusions on this subject embodied in this report are due almost wholly to his personal work, the extent and amount of which can only be appreciated by a close study of the elaborate details shown in the tables and diagrams. He has also, as usual, taken my place in the lecture-room during absences.

Professor Woodworth, in addition to lecture and laboratory work with three classes, has steadily carried on experimental work on the grounds, and is constantly in receipt of specimens of insects, diseased plants, insecticides, etc., which, together with an extensive correspondence on the same and cognate subjects, occupies his time very fully. His contributions to the present report, and that of one of his students, Miss Tyrrell, illustrate fairly the kind and method of work pursued by him. He has also made several professional excursions to the southern and other parts of the State, for the purpose of ascertaining by personal study the actual and probable success of several of the imported scale-destroyers, whose practical value is still in doubt.

Professors Loughridge and Woodworth have also conjointly made numerous photographs of objects of study and investigation, part of which appear in the present report, while others are reserved for the future.

I may, in conclusion, summarize the situation by stating that the entire Station staff is engaged, almost throughout the year, in extremely active work, whose intrinsic interest compensates in a measure for the almost entire extinction of their vacation.

Respectfully submitted.

E. W. HILGARD.

Berkeley, California.

I.

REPORTS ON GENERAL WORK IN THE AGRICULTURAL LABORATORIES.

Analyses of Soils, Alkali and Alkali Soils, Waters, Rocks and Minerals, Fertilizers, Gypsum, Fruits and Vegetable Products (Food-Material, Figs, Oranges, Lemons, Prunes, Apricots, Plums, Bananas, Olives, Cherries, Persimmons, Logan Berry, Sugar Beets, Etc.); Discussion of the Same, and Related Subjects.

RECORD AND DISCUSSIONS OF WORK IN THE CENTRAL AGRICULTURAL LABORATORIES.

EXAMINATIONS AND ANALYSES OF SOILS, ALKALI, WATERS, FEEDING-STUFFS, FRUITS, AND MISCELLANEOUS SUBSTANCES.

I. EXAMINATION OF SOILS.

During the period covered in this report there have been more than 150 samples of soils sent in to this Station from parties throughout the State, for examination either as to need of fertilization, fitness for certain crops, or the presence of some cause productive of injury to trees or crops. In the great majority of cases nothing more than a partial analysis was necessary; and an acquaintance with the character and composition as well as the climatic conditions of the majority of soils of the State enabled us to give the desired information and to offer suggestions as to the capabilities or treatment of the soil in question.

The greater part of the time of Professor Loughridge has been devoted to analyses of several hundred samples of alkali soils from Tulare and Chino, in the effort to solve important problems connected with that highly important class of lands in our State. The results are presented under the head of Alkali, in this report.

Four soils from Perris Valley, one from Ventura County, and one from Hollister are the only ones which received a full analysis by Mr. Jaffa, because of necessary work in other lines of investigation, such as nitrogen in soils, composition of foodstuffs, etc.

No. 1704. *Hollister Valley Soil*, from the orchard part of the Ladd ranch (division of the San Justa Rancho), 2½ miles southeast of Hollister, San Benito County. The valley proper is about 20 feet above a bench-land bordering San Benito River, and 40 feet above the river-bed. Sample taken 12 inches deep. It is a dark loam (without gravel), which becomes plastic on wetting. The subsoil is very similar. The land is now covered with fruit trees, embracing prunes, peaches, apricots, and a few cherries, now in their fourth year (1895), and very thrifty. The sample was sent by Messrs. Briggs and Hamilton, of Hollister.

No. 1704. *Soil of Ladd Ranch, Hollister Valley.*

Coarse materials $>0.5^{\mathrm{mm}}$	0.5
Fine earth	99.5

Analysis of Fine Earth.

Insoluble matter	67.37	80.34
Soluble silica	12.97	
Potash (K_2O)		.45
Soda (Na_2O)		.34
Lime (CaO)		1.16
Magnesia (MgO)		2.09
Br. ox. of manganese (Mn_3O_4)		.03
Peroxid of iron (Fe_2O_3)		5.71
Alumina (Al_2O_3)		5.87
Phosphoric acid (P_2O_5)		.16
Sulphuric acid (SO_3)		.07
Carbonic acid (CO_2)		----
Water and organic matter		3.72
Total		99.94
Humus		.94
Ash		.58
Nitrogen in 100 humus		5.21
Nitrogen in 100 fine earth		.049
Hygroscopic moisture (absorbed at 15° C.)		5.22

The soil shows no obvious deficiency in plant-food for the present. It has a great abundance of phosphoric acid and lime, but for California its potash and nitrogen (in humus) are rather low, and the latter especially seems likely to require replenishment first of all. This can be done by either plowing-under a green crop, say of burr clover or horse beans (not of rye or other grasses, which would be of little use); or else the unirrigated land can be fertilized with Chile saltpeter, at the rate of 100 pounds per acre, or with tankage at the rate of 250 pounds.

The supply of available potash can doubtless be made adequate by using some two or three hundred pounds of gypsum per acre; in the future the use of potash may be necessary in fertilization.

Hollister Valley lower bench soil from the above locality; sent by Messrs. Briggs and Hamilton. It lies 20 feet lower than the valley. An examination shows it to be a heavier soil than the latter, with more lime and about the same amount of phosphoric acid. It probably does not at present require fertilization of any kind. Being stiffer, it is not so well adapted to such trees as peaches, almonds, and the like, as that of the higher land, but should do finely for plums, apricots, etc. There seems, from the data given, to be no lack of depth or drainage in either of the above soils.

As regards irrigation, we see in Merced and Tulare Counties that after trees once pass the first four years in safety, twelve inches of average rainfall will answer without irrigation in certain soils; but there is a risk of failure to fill-out to a sufficient size in case of a failure of late rains. In other words, the command of irrigation water is very important for the regular attainment of full crops of marketable quality, and the water should be applied as necessity may arise, not necessarily at any definite time. In the climate of Hollister, so far as known, late irrigation to insure the filling of the fruit is most likely to be called for.

No. 1714. *Bench-land soil*, from the olive orchard, Piru Ranch, Ventura County; sent by Leslie F. Gay, manager. This land produces the largest olives grown on that ranch.

Coarse materials$>0.5^{mm}$		33.58
Fine earth		66.42

Analysis of Fine Earth.

Insoluble matter	82.11	88.99
Soluble silica	6.88	
Potash (K_2O)		.47
Soda (Na_2O)		.42
Lime (CaO)		.67
Magnesia (MgO)		.57
Br. ox. of manganese (Mn_3O_4)		.04
Peroxid of iron (Fe_2O_3)		5.26
Alumina (Al_2O_3)		1.30
Phosphoric acid (P_2O_5)		.21
Sulphuric acid (SO_3)		.09
Carbonic acid (CO_2)		----
Water and organic matter		2.23
Total		100.25
Humus		.78
Ash		.52
Nitrogen per cent in humus		9.56
Nitrogen per cent in soil		.074
Hygroscopic moisture (absorbed at 15° C.)		3.75

This is an easily tillable soil, rich in phosphoric acid and potash, and with a fair amount of lime. The nitrogen and humus percentages are very fair for this class of lands. The conditions are therefore very favorable to the full growth of the olive, so far as elements of plant-food are concerned.

PERRIS VALLEY, RIVERSIDE COUNTY.

[The following description and notes on Perris Valley are based partly on personal observations made on the occasion of a Farmers' Institute at the town of Perris, in May, 1895; partly from data furnished by Mr. Ora Oak, a prominent resident of the place. It is thought that such descriptions of regions little known to the general public are a desirable feature, which should be more frequently introduced. A similar description of Antelope Valley, on the Mojave Plateau, is being prepared for the next report.]

The region south of the San Bernardino Valley and the San Gorgonio Pass is high and mountainous, with the San Jacinto mountain ranges as its backbone. On the western slope of this range is a broad plateau known as the San Jacinto Plains, which lies directly south from Riverside and, with the Temescal range as its western boundary, has an area of about 25 miles square, and an elevation of from 1,300 to 1,500 feet above sea-level. This plateau is about 40 miles from the ocean in an air-line, and is climatically affected by the Temescal range, which deflects the sea breeze and stops the incoming fogs.

In this plateau rise broken granitic hills, dividing it into numerous small valleys. Through breaks in these hills the San Jacinto River comes in from the east and runs (in the winter and spring) in a southwesterly direction through the valley toward Lake Elsinore. The plateau proper is treeless, except that along the river, near the mountains, there is a belt of cottonwood; the hills are or were once covered with a thick growth of mountain mahogany, greasewood, sage, etc., but no large trees. There are numerous springs of good water in the hills, which supply many small ranches. A number of towns are scattered over the plateau, San Jacinto being quite large.

Perris Valley is one of the small valleys of this plateau, and is located to the west of the central range of granite hills mentioned. Along its western boundary lies another low range of broken granite hills, in which are numerous springs, which yield but a limited amount of water, scarcely enough for domestic use, but practically undeveloped. Four miles farther west is another range of higher hills, bordering the Temescal Cañon and forming the true western boundary of the valley and plateau. This range embraces the Pinacate mining district.

Perris Valley is joined by Alessandro Valley on the north and Menifee Valley on the south, thus forming a continuous, open country, with no natural dividing lines; Perris Valley proper is, therefore, 10 miles long and 6 miles wide, with an area of about 40,000 acres. It has a gentle slope from the east and west toward the San Jacinto River in the center, the base of the foothills being about 50 feet higher than the river. It also has a slight fall to the south. The soil along the foothills is chiefly of disintegrated granite, that on the western slope being coarser than that on the eastern side. Hardpan locally underlies the soil at depths varying from 2 to 10 feet. In the center of the valley there is a belt comprising 4,000 to 5,000 acres of nearly level land, of heavier soil, more or less impregnated with "white" alkali. The water-level under this bel tis from 8 to 15 feet below the surface. Perris Valley is apparently well furnished with an underground supply of water, either through an old lake-bed or river channel. The largest stratum of water so far developed lies from 75 to 100 feet below the surface, in gravel and quicksand. This vein has been tapped by bored-wells several miles apart and on either side of the valley, but the volume and extent of the water-belt are not yet definitely settled. The wells have been tested sufficiently by pumping to show a continuous yield of 30 to 60 miner's inches. The best wells and best water are, as far as developed, on the east side of the valley. No artesian flow has been developed, though wells have been sunk about 500 feet in search of it. The water rises to within 10 to 35 feet of the surface in most parts of the valley.

Citrus and deciduous fruits have been planted in the valley, especially along the western foothills, and promise well, as four-year-old trees have borne satisfactorily. The largest acreage is in prunes; peaches, apricots, and plums show great vigor, while the almond trees have made the largest growth. Alfalfa is being successfully raised on portions of the central belt, and the large portion of this tract will probably be thus utilized. The Australian saltbush appears to do well in the valley. The climate averages 40° in winter and 95° in summer, though extremes show as low as 25° in winter and as high as 105° in summer. Fogs are rare and the climate is very healthful.

The accompanying weather report was made by Mr. R. W. Blake, of Perris, and represents a period of the year from July, 1894, to March, 1895, a summary of a portion of the time only being given.

The cold seems to be divided into three belts: coldest at the bottom or lowest part of the valley, medium at the middle of the valley, and warm at the foothills. When there is a heavy frost in the bottom-land of the valley there is a light frost in the middle, and none at the foothills; and when there is a light frost in the foothills there is a heavy freeze at the bottom of the valley.

The temperatures above reported were taken midway of the valley, and therefore represent a mean of the entire region.

WEATHER REPORT FOR PERRIS, RIVERSIDE COUNTY, SIX MONTHS ENDING MARCH, 1895.

Taken by R. W. BLAKE, Perris.

Date	September, 1894.					October, 1894.					November, 1894.					December, 1894.					January, 1895	February, 1895.					March, 1895.				
	Temperature.				Rainfall—Inches	Temperature.				Rainfall—Inches	Temperature.				Rainfall—Inches	Temperature.				Rainfall—Inches		Temperature.				Rainfall—Inches	Temperature.				Rainfall—Inches
	6 A. M.	12 M.	6 P. M.	Daily Av.		6 A. M.	12 M.	6 P. M.	Daily Av.		6 A. M.	12 M.	6 P. M.	Daily Av.		6 A. M.	12 M.	6 P. M.	Daily Av.			6 A. M.	12 M.	6 P. M.	Daily Av.		6 A. M.	12 M.	6 P. M.	Daily Av.	
1	62	84	74	70	.00	38	64	57	53	.00	48	74	61	64	.00	32	58	48	46	.00	No report for this month.	36	62	58	52	.00	50	74	68	64	.00
2	62	85	72	73	.00	39	85	80	68	.00	40	80	69	63	.00	38	61	54	52	.00		37	67	52	52	.00	42	74	64	60	.00
3	60	83	73	72	.00	50	88	81	78	.00	40	84	62	62	.00	22	72	62	52	.00		34	66	56	60	.00	42	72	66	60	.00
4	58	85	75	72	.00	48	94	80	74	.00	48	82	65	65	.00	30	66	60	52	.50		39	66	57	54	.00	43	74	66	61	.00
5	58	84	74	72	.00	50	90	73	72	.00	40	85	64	63	.00	46	54	42	44	1.00		39	66	51	52	.00	44	70	66	60	.00
6	55	84	71	70	.00	62	86	71	71	.00	40	88	76	68	.00	48	58	41	49	.125		39	64	50	51	.00	42	66	60	56	.00
7	52	88	73	71	.00	46	88	73	73	.00	42	86	76	68	.00	38	52	44	45	.00		39	64	58	53	.00	42	66	60	56	.00
8	50	88	84	73	.00	48	88	71	69	.00	36	80	70	62	.00	40	56	42	46	.375		39	58	41	46	.40	52	64	61	59	.00
9	60	90	84	78	.00	45	88	67	69	.00	40	80	72	64	.00	40	64	41	47	.06⅔		44	48	43	45	.20	54	60	57	57	.00
10	56	94	87	79	.00	44	74	65	71	.00	42	80	73	65	.00	40	60	44	48	.00		42	54	39	45	.10	54	60	57	57	.00
11	52	94	85	77	.00	54	74	64	61	.00	44	84	70	66	.00	27	56	40	41	.06⅔		44	54	43	47	.10	54	60	57	57	.00
12	48	86	70	68	.00	44	92	80	64	.00	40	80	72	64	.00	34	51	41	44	.00		46	58	43	49	.00	54	56	52	54	.00
13	56	80	71	69	.00	46	92	81	72	.00	32	84	73	63	.00	44	55	54	51	.06⅔		44	58	48	50	.00	54	56	46	52	.10
14	46	90	71	69	.00	46	86	72	73	.00	34	78	71	61	.00	46	52	49	49	.06⅔		46	66	43	55	.00	36	52	44	44	.00
15	50	90	85	75	.00	42	90	72	68	.00	32	74	63	53	.00	52	60	51	51	.00		44	56	44	48	.00	24	64	45	41	.00
16	56	91	78	75	.00	46	92	75	68	.00	46	72	62	60	.00	40	68	54	51	.00		38	58	45	47	.00	28	60	59	49	.00
17	52	88	78	73	.00	56	80	68	71	.00	32	72	55	53	.00	30	64	56	50	.00		38	68	59	55	.00	40	50	44	44	.00
18	60	88	80	76	.00	54	68	65	66	.00	30	76	56	64	.00	42	58	60	60	.00		34	74	63	57	.00	44	50	47	47	.10
19	60	90	81	77	.00	54	68	61	61	.00	30	76	59	55	.00	50	58	51	53	1.50		34	72	65	57	.00	38	60	52	50	.00
20	46	90	80	72	.00	48	66	57	57	.00	30	72	57	53	.00	32	63	40	45	.00		40	70	61	57	.00	38	60	46	48	.00
21	50	98	83	77	.00	50	70	60	60	.00	29	72	62	51	.00	30	60	42	44	.00		38	66	61	53	.00	46	66	50	54	.00
22	50	94	81	75	.00	40	85	70	65	.00	46	60	56	54	.00	32	58	48	46	.00		60	70	42	54	.00	50	70	51	57	.00
23	46	91	80	72	.00	44	70	60	58	.00	32	74	62	56	.00	30	58	46	44	.06⅔		40	74	45	51	.00	50	72	61	61	.00
24	50	90	82	74	.00	52	74	94	60	.00	32	78	61	57	.00	30	58	47	45	.00		50	60	46	52	.00	52	74	60	62	.00
25	60	88	80	76	.00	42	83	71	65	.00	32	78	55	55	.00	42	58	41	47	.00		46	70	61	59	.00	42	82	62	62	.00
26	48	96	81	75	.00	52	80	67	63	.00	32	69	55	52	.00	46	56	48	50	.06⅔		46	70	64	60	.00	50	82	63	65	.00
27	46	74	62	60	.00	52	70	61	61	.00	44	60	46	50	.00	42	60	57	51	1.00		55	74	63	64	.00	50	70	60	60	.60
28	46	70	61	59	.00	37	76	61	58	.00	34	66	53	51	.00	42	54	51	49	.75		42	76	68	62	.00	54	60	51	55	.20
29	42	74	65	57	.00	38	80	68	52	.00	29	62	41	41	.00	42	54	51	49	1.375							46	48	47	47	.00
30	50	66	60	59	.50	32	82	66	60	.00	33	60	45	46	.00	50	60	54	55	.20							30	60	51	47	.00
31						34	76	61	57	.00						50	61	51	54	.00							30	72	51	51	.00

REMARKS.	REMARKS.	REMARKS.	REMARKS.	REMARKS.	REMARKS.
Average temperature per day, 71 19-30°. Duration of fog and mist not over six hours during the month. Total rainfall for the month, ½ inch. There were 11 heavy and 5 light dews. Cloudy weather not over 24 hours. There were but few hours during the month that the sun was hidden by clouds. Prevailing winds, northwest.	Oct. 17th, rainbow in west; 6 P. M. light thunder and lightning. Oct. 29th, heavy wind and dust storm. Highest temperature, 94° on the 4th. Lowest temperature, 32° on the 30th. Mean average, 66 19-31°. There were 4 hours of heavy fog. Eight heavy and 5 light dews. Total rainfall, ⅛ of an inch. Prevailing winds, northwest. Three light shocks of earthquake.	Nov. 17th, 19th, 24th, light frosts. Nov. 15th, 18th, 20th, 26th, 29th, heavy frosts. Highest temperature, 88° on the 6th. Lowest temperature, 29° on the 29th. Three heavy and 1 light fog. Six light dews. Twenty-three heavy dews. Prevailing wind, northwest.	December 13th, heavy dust storm. Daily average temperature, 47½°. Direction of wind, south. Eighteen heavy frosts. Eight frosts. Twenty-two cloudy days, 10 heavy clouds. Seven heavy and 1 light fog, in all lasting 21 hours. Total rainfall, 5.20 inches. The month has been damp and cool, with no winds. One heavy earthquake.	Highest temperature, 76°. Lowest temperature, 34°. Daily average, 53°. Total rainfall, .80 of an inch. Prevailing wind, northwest. Heavy dew every night.	Total rainfall for March, 1 inch. Daily average temperature, 58°. Heavy dew every night. Prevailing wind, northwest.

REMARKS ON SIX MONTHS BEGINNING JULY AND ENDING DECEMBER 31, 1894.

Prevailing winds, northwest, and no hard winds.

Average cloudy weather, 25 hours per month for five months, while December was cloudy nearly the entire month.

There were but 46 hours of fog.

There were 3 heavy dust-storms, and 3 light thunder-storms.

Highest temperature, 102° on July 8th.

Lowest temperature, 22° on December 22d.

Average monthly temperatures: July, 78½°; August, 79°; September, 71¾°; October, 66¾°; November, 61⅛°; December, 47½°. Monthly average temperature, 68°.

There have been during last six months, 6 rainbows, 3 fog bows, and 1 meteor.

Earthquakes: In July, 2 light ones; in October, 3 light ones; in December, 1 heavy one. No damage.

There have been 8 mists and rainfall, as follows: July, 3 light showers—$\frac{1}{12}$ inch; August, ½ inch rain; September, ½ inch rain; October, 3 light showers—¼ inch rain; December, 14 rain-storms—5$\frac{3}{16}$ inches rain. Total rainfall in 6 months, 6½ inches.

Observations show Perris Valley to be remarkably free from rain, dust-storms, dews, and fogs during July, August, September, and October. The weather is hot and dry, suited to drying fruit, most of which ripens during those months, while November and December have heavy dews and rains, with some few fogs, wet and cool, just suited to plowing, growing of all small grain, and the setting of trees, plants, shrubs, and vines.

SOILS OF PERRIS VALLEY.

The following specimens of soil from the central belt of valley land, more or less charged with alkali salt, were sent by Mr. Ora Oak, of Perris, and partly examined. They represent the different characters of land in the valley, viz., *reddish foothill lands, brownish loams, black calcareous adobe*, and *alkali land.*

Red lands of the foothills. These lands form a belt of from one half to three quarters of a mile wide at the foot of the knolls and hills on the south and west of the valley, and are formed from the granites and slates of those knolls. The following specimens were received:

Yellowish sandy soils with gravel, from the foot of hills northwest of Menifee, on the west side of the valley. Sent by W. H. Harvey and E. E. Waters.

Deep red soil from the foot of a granite knoll on the Perley place, near Rocky Hill, northwest of Menifee; south end of valley. Taken by E. W. Hilgard.

Brownish valley lands. These lie between the belt of foothill red lands and the more central dark lands, apparently intermixtures of the two, though not calcareous or alkaline. One sample has been received from F. J. Fogg, of Perris, from the citrus belt of the valley north of Perris.

Calcareous adobe lands. In the southern part of the valley and lying along the south of the river there is a broad tract of stiff, black adobe, highly calcareous and not alkaline in character. A specimen from the Hoag place, obtained by Professor Hilgard, had a growth of salt grass, sunflower, etc. Another sample of soil, etc., to three feet in depth, from L. D. Mapes and said to represent a tract of 1,000 acres, is of a bluish tint, highly calcareous in character, and is interspersed with powdery particles of carbonate of lime.

Ash-colored sediment land. In the northern part of this central portion of the valley, and adjoining the southern part of Allessandro Valley, there is a large tract of ash-colored sediment land, as shown by specimens of soil, subsoil, and underclay sent by L. K. Shaw, from north of the Indian school-house. These samples seem to be very similar to the depth represented—three feet. Water is said to be obtained at 45 feet.

Alkali land. A tract of this character occupies the central part of the valley on the north of the river and west of the sediment land, reaching nearly through the valley northward. On the south of the river, and north of Winchester, there is another tract of the alkali, doubtless arising from evaporation of local drainage without outlet. A sample of soil and subsoil from the place of H. M. Bangle, near Winchester, contains much of this white alkali.

The soil is rather a dark loam, more or less charged with alkali, not of the "black" kind (carbonate of soda), but of the "white" (sulphate of soda), which is much less hurtful. The belt is about one mile wide, with a length of 8 miles in Perris Valley, 5 miles in Pleasant Valley, and 3 miles in Menifee Valley, but not continuous. The following samples were sent by Ora Oak, of Perris, and have been analyzed with the results given below:

No. 1758. *Saline soil* of a "bare spot" lying in the central part of the valley, and showing efflorescence of alkali salts, with alkali grass and salt weeds.

No. 1759. *Soil*, taken near the latter, but on higher land. It bears a growth of alfileria and grasses, and has a trifle amount of alkali.

No. 1760. *Calcareous soil* from the northern part of the valley. It bears a growth of green sage (*Bigelovia*, a kind of goldenrod).

No. 1761. *Calcareous subsoil*, taken from the side of a well near No. 1758. It contains fragments of carbonate of lime.

ANALYSIS OF SALINE LANDS OF PERRIS VALLEY. By M. E. Jaffa.

	No. 1758. Bare Spot Soil.	No. 1759. Higher Land Alfileria Soil.	No. 1760. "Green Sage" Land Soil.	No. 1761. Calcareous Subsoil.
Coarse materials > 0.5mm	7.50	17.50	3.50	*14.00
Fine earth	92.50	82.50	96.50	86.00
Analysis of Fine Earth.				
Insoluble matter	41.59 } 63.13	62.09 } 76.36	35.20 } 58.95	26.97 } 50.86
Soluble silica	21.54	14.27	23.75	23.89
Potash (K_2O)	1.37	.84	1.16	1.01
Soda (Na_2O)	1.97	.77	.69	1.07
Lime (CaO)	4.23	2.19	8.00	13.94
Magnesia (MgO)	3.80	2.32	5.69	6.16
Br. ox. of manganese (Mn_3O_4)	.03	.02	.04	.05
Peroxid of iron (Fe_2O_3)	9.65	6.87	7.33	5.93
Alumina (Al_2O_3)	7.26	7.15	6.29	5.29
Phosphoric acid (P_2O_5)	.23	.12	.28	.22
Sulphuric acid (SO_3)	.34	.22	.21	.44
Carbonic acid (CO_2)	4.19	Trace.	6.49	10.13
Chlorine (Cl)	.72	.02	Trace.	.50
Water and organic matter	2.89	3.08	4.71	4.29
	99.81	99.96	99.84	99.89
Less excess O due to Cl	.16	.00	.00	.11
Total	99.65	99.96	99.84	99.78
Humus	.60	.53	.91	------------
Ash	.92	.47	1.75	------------
Nitrogen in 100 humus	6.666	11.04	7.70	------------
Nitrogen in 100 fine earth	.040	.059	.07	------------
Hygroscopic moisture (absorbed at 15°C.)	9.43	5.08	8.85	14.19
Available phosphoric acid (soluble in 2 per cent solution of citric acid)	.079	.023	.119	.056

* Contains 20 per cent of calcium carbonate.

Leachings of Air-Dried Soil.

	No. 1758.		No. 1759.		No. 1760.		No. 1761.	
	In 100 of Soil	Per Cent Composition	In 100 of Soil	Per Cent Composition	In 100 of Soil	Per Cent Composition	In 100 of Soil	Per Cent Composition
Total residue	1.20	------	.042	------	.048	------	1.400	------
Sodium chlorid	1.13	94.17	.028	66.66	Tr.	------	.779	55.64
Sodium nitrate	Tr.	Tr.	.002	4.76	.016	33.34	.009	.64
Sodium sulphate	.04	3.33	.012	28.57	.032	66.66	.612	43.72
Potassium sulphate	.03	2.50	------	------	------	------	------	------

Another sample sent by Mr. Oak yielded 2.31 parts of soluble salts per 100 of soil. The salts comprised chiefly sodium chlorid (common salt) and carbonates of lime and magnesia.

In general character these soils agree entirely with most of the higher class of alkali soils in this State, being very rich in potash, lime, and (excepting No. 1759) in phosphoric acid also; a large part of the latter being in a directly available condition. The supply of humus is only fair, and that of total nitrogen low, but the presence of niter in the waters shows it to be largely in the available form of nitrates, especially in Nos. 1759 and 1760.

The large amount of alkali (1.2 per cent) in the soil from the bare spot No. 1758 shows plainly the cause of its bareness; such a percentage within the first foot of soil being too much for almost any but the most hardy alkali plants. Since, moreover, almost the whole of this is common salt, the only possible mode of reclaiming such land would be under-drainage and flooding. Even then it would be necessary first to ascertain the amount of alkali salts contained at a greater depth in order to reach a safe conclusion as to the reclaimability. The fact that in the case of No. 1761 the second foot contains nearly 1½ per cent of soluble salts, shows the importance of this reservation. It should be noted that in this subsoil we have 14 per cent of lime, showing that over one quarter of this soil-mass consists of the carbonate of lime. This fact was apparent to the naked eye on the sides of the pumping pit of well No. 1, which, down to the depth of 8 feet, seemed to consist of the same materials heavily charged with alkali salts. Such accumulations have been observed elsewhere (e. g., in Antelope Valley) in the drainage-axis, and are usually of little extent.

The small amount of alkali salts contained in the alfileria and green-sage lands should not prevent a ready cultivation, although under irrigation more alkali may rise to the surface; the green-sage land especially should be profusely productive, as it contains extraordinary amounts of soluble plant-food, including not less than 640 pounds of Chile saltpeter per acre within the first foot; resembling in this respect the best lands of the Chino Ranch. Such land as this is evidently worth serious consideration, even if its cultivation should be attended, for a time, with some extra trouble and expense.

Of the alkali-free slope-soils of the valley none have as yet been thoroughly examined; but their native vegetation, as well as the cultural results already apparent, afford ample proof of their high productiveness. The extraordinary growth of almond trees in the middle and upper part of the slope-land seems to point to that nut as one of the most prominent productions of the valley.

The heavy clay or adobe lands lying along the San Jacinto River in its lower course through the valley, while difficult to cultivate, will doubtless be very productive under intense culture, and seem to be free from the alkali which appears in the same relative position southwards of the town of Perris.

WELL WATERS FROM PERRIS VALLEY, RIVERSIDE COUNTY.

	No. 1. Unused Well 60 Feet Deep.		No. 2. Unused Well 90 Feet Deep.		No. 3. Well 70 Feet Deep.		No. 4. Pound Well.		No. 5. Harvey Well.		No. 6. Waters Well.	
	Grains per Gallon.	Parts in 10,000.	Grains per Gallon.	Parts in 10,000.	Grains per Gallon.	Parts in 10,000.	Grains per Gallon.	Parts in 10,000.	Grains per Gallon.	Parts in 10,000.	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	67.58	11.57	75.12	14.06	26.55	4.34	62.03	10.62	52.98	9.05	27.45	4.70
Soluble in water after evaporation	40.88	7.00	42.05	7.20	11.25	1.93	38.55	6.60	22.19	3.80	9.70	1.66
Insoluble in water after evaporation	16.88	2.89	18.93	3.46	11.94	1.93	15.30	2.62	18.58	3.18	10.75	1.84
Organic matter and chemically combined water	9.82	1.68	14.14	3.40	3.36	.58	8.18	1.40	12.25	2.07	7.00	1.20
The soluble part consists of—												
Sodium and potassium sulphates (Glauber's salt, etc.)	9.14	1.58	7.06	1.21	1.83	.30	1.04	.20	4.08	.71	1.69	.31
Sodium chlorid (common salt)	28.64	4.89	32.52	5.57	8.18	1.40	37.51	6.40	16.26	2.78	6.78	1.14
Sodium carbonate (sal soda)	3.10	.53	2.47	.42	1.24	.23	--------	--------	1.85	.31	1.23	.21
The insoluble part consists of—												
Calcium and magnesium carbonates	9.55	1.63	14.60	2.50	8.03	1.36	10.51	1.80	15.18	2.60	5.49	.94
Calcium sulphate (gypsum)	4.47	.77										
Silica	2.86	.49	4.33	.96	3.91	.67	4.79	.82	3.40	.58	5.26	.90
Nitrates	--------	.024	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

WATERS OF PERRIS VALLEY.

The accompanying analyses of the well waters from the central part of Perris Valley have been made. The samples were sent by Mr. Oak, of Perris.

No. 1. *Water from an old, unused well*, 60 feet deep; taken at 15 or 20 feet from the surface.

No. 2. *Water from an old, unused well*, 90 feet deep.

No. 3. *Water from a well* 70 feet deep; taken at 26 feet by windmill.

No. 4. *Water from well* of Henry Pound, near Perris; depth of well not stated.

No. 5. *Well water* from near Menifee; sent by W. N. Harvey.

No. 6. *Well water;* sent by E. E. Waters, near Menifee.

The prominent characteristic of all these waters is the predominance of common salt over the rest of the soluble ingredients, and the small amount of carbonate of soda, or black alkali, present.

In Nos. 1, 2, and 4, the content of salts, and more particularly of common salt, is so great that they could not be used for irrigation for any length of time without impregnating the soil with "white alkali," unless the water were used in such quantities as to leach the salts through into the subdrainage. For domestic use, also, they are rather too strongly impregnated with soluble salts, besides being extremely "hard."

Waters Nos. 3 and 6, however, are quite within the limits for both kinds of use, although, also, somewhat hard.

Water No. 5 is on the line between potable and non-potable waters. Being, moreover, extremely "hard," it is not desirable water for domestic use, but in light, pervious soils can be used for irrigation without serious danger from alkali.

The small amount of nitrates indicated by the examination of water No. 1 is certainly derived from the soil itself, as is the case in all alkali lands, and is no mark of contamination any more than the contents of common salt.

It should be observed that all these waters were taken from wells sunk near the central line of the valley, in ground showing alkali at the surface, in order to test their fitness for irrigation. Even here, as the record shows, water can be found that is perfectly available for irrigation and domestic use; and additional boring will doubtless locate more definitely the belts and depths at which the best water can be found and made available by tubing out, if necessary, the salty streams that may be encountered at higher levels.

The wells sunk away from the central portion of the valley, and especially near the foothill slope, have excellent soft water, but they have not as yet received special examination.

SOILS SENT FOR EXAMINATION.

Name.	Locality.	County.	Sender.
	Foothills & Sierra Range.		
Soil	Newcastle	Placer	J. D. Mathews.
Granitic soil	Roseville	Placer	J. D. Gould.
Soils (9)	Bishop, Owens Valley	Inyo	F. F. Connelly.
Micaceous soil	Kent	Sutter	— Andrew.
	Great Valley Region.		
Red sandy soil	Corning	Tehama	W. T. Reid.
Black soil	San Emedio Ranch	Kern	
Hard adobe soil	Merced	Merced	H. A. W. Forchiana.
Sandy loam	Merced	Merced	H. A. W. Forchiana.
Reddish gravelly clay	Rotterdam Col., Merced	Merced	T. J. Van Outeran.
Whitish gravelly clay	Rotterdam Col., Merced	Merced	T. J. Van Outeran.
Soil and rounded pebbles	Rotterdam Col., Merced	Merced	T. J. Van Outeran.
Soils (3)	Delano	Kern	George L. Withers.
Black alkali soil		Kern	— Barker.
Non-alkali soil		Kern	— Barker.
Soil	Kingsburg	Fresno	Miss Boot.
Sandy soils (4)	Tulare	Tulare	S. M. Watkins.
Soils (3)	Dutton's Landing	Solano	J. W. Dutton.
Soils	Bakersfield	Kern	L. W. Burr.
Soils (7)	Fresno	Fresno	L. Braverman.
Soil	Tracy	San Joaquin	P. Fabian.
Peaty tule soils (4)	Winters Island	Sacramento	J. C. Kelsey.
	Coast Range Region.		
Soil	Petaluma	Sonoma	J. P. Denman.
Soils (4)	Byron	Contra Costa	G. W. L. Carter.
Soils	Point of Timber	Contra Costa	H. A. P. Carter.
Soils (2)	San José	Santa Clara	A. H. Washburn.
Soil	San José	Santa Clara	R. S. Cusick.
Stiff red soil	Saratoga	Santa Clara	J. T. Richards.
Soils (2)	Goodwin	S. L. Obispo	Peter McCort.
Soils (6)	Montecito	S. Barbara	J. H. Slayter.
Soil	Santa Clara	Santa Clara	O. B. Kimberlin.
Soil	San José	Santa Clara	W. A. Cooper.
Soils			Briggs & Hamilton.
Soil	San Miguel	S. L. Obispo	R. Guess.
Stiff red clay soil	Byron	Contra Costa	Mrs. F. E. Wilder.
Light clay soil	Byron	Contra Costa	Mrs. F. E. Wilder.
Reddish soil	Gilroy	Santa Clara	F. H. Brooks.
Soils (2)	Santa Maria	S. L. Obispo	W. J. Phelps.
Sediment soil	Hillsdale	Santa Clara	H. J. Agnew.
Soils	San José	Santa Clara	Wm. B. Cragin.
Adobe	Santa Clara	Santa Clara	O. B. Kimberlin.
Dark yellow soil	Saratoga	Santa Clara	C. S. Brolly.
Yellow soil	Saratoga	Santa Clara	C. S. Brolly.
Light yellow soil	Saratoga	Santa Clara	C. S. Brolly.
Subsoil	San José	Santa Clara	Blany & Cooper.
Red rocky soil	Almaden Viney'd, S. Jos.	Santa Clara	Mr. Lefranc.
Dark loam soil and subsoil	Hollister	San Benito	Briggs & Hudner.
Bench land soil and subsoil	Hollister	San Benito	Briggs & Hudner.
Light loam soil	Morgan Hill	Los Angeles	J. H. Henry & E. S. Jones.
Light loam soil	Morgan Hill	Los Angeles	J. H. Henry & E. S. Jones.
Light pebbly loam	Morgan Hill	Los Angeles	J. H. Henry & E. S. Jones.
Soils	Oakland	Alameda	F. H. Brooks.
Soils	Tipton	Santa Clara	H. Agnew.
Soil	Piru	Ventura	Leslie Gay.
	Southern Cal. Region.		
Soils (10)	Sweetwater Valley	San Diego	R. C. Allen.
Soils	San Dimas	Los Angeles	Collins Bros.
Soils (4)	Riverside	Riverside	Everest Ranch.
Sediment soil	Tehachapi Mts. Reserv'r	Kern	— Washburn.
Soils (2)	Redlands	S. Bernard'o	H. Cousins.
Clay loam soil	Orange	Orange	J. A. Whittaker.

CHEMICAL ANALYSES OF SOILS AND SUBSOILS OF CALIFORNIA.

Number	Soil Title.	Locality.	County.	Depth, in Inches	Characteristic Vegetation.	Insoluble Residue	Silica Soluble in Carbonate of Soda	Total Residue and Soluble Silica	Potash	Soda	Lime	Magnesia	Br Ox. of Manganese	Ferric Oxid	Alumina	Phosphoric Acid	Sulphuric Acid	Carbonic Acid	Chlorine	Water and Organic Matter	Total	Humus	Ash	Nitrogen in Humus	Nitrogen in Soil	Available Phosphoric Acid	Hygroscopic Moisture	Temperature of Absorption (cent. degrees)	Number	Analyst
		Coast Range.																												
1701	Hollister Valley soil....	Ladd Ranch, 2½ miles S.E. of Hollister.	San Benito	12	Cultivated	67.37	12.97	80.34	.45	.34	1.16	2.09	.03	5.71	5.87	.16	.07	......	......	3.72	99.94	.94	.58	5.21	.049	.....	5.22	15	1701	.... Jaffa.
1714	Bench soil	Piru Ranch, olive orchard...	Ventura	12	Cultivated	82.11	6.88	88.99	.47	.42	.67	.57	.04	5.26	1.30	.21	.09	......	......	2.23	100.25	.78	.52	9.66	.074	...	3.75	15	1714	.... Jaffa.
		Southern California.																												
1758	Bare alkali soil.........	Perris Valley, central part.........	Riverside.........	12	....	41.59	21.54	63.13	1.37	1.97	4.23	3.80	.03	9.65	7.26	.23	.34	4.19	.72	2.89	99.81	.60	.92	6.66	.040	.079	9.43	15	1758	.... Jaffa.
1759	Higher alfileria soil.....	Perris Valley, central part	Riverside	12	Alfileria, grasses	62.09	14.27	76.36	.84	.77	2.19	2.32	.02	6.87	7.15	.12	.22	....	.02	3.08	99.96	.63	.47	11.04	.050	.023	5.08	15	1759	.... Jaffa.
1760	"Green sage" soil	Perris Valley, northern part	Riverside	12	Green sage	35.20	23.75	58.95	1.16	.69	8.00	5.69	.04	7.33	6.29	.28	.21	6.49	Tr.	4.71	99.84	.91	1.75	7.70	.070	.119	8.85	15	1760	.... Jaffa.
1761	Calcareous subsoil ...	Perris Valley, central part.............	Riverside	12-24	....	26.97	23.89	50.86	1.01	1.07	13.94	6.16	.05	5.93	5.29	.22	.44	10.13	.50	4.20	99.89	....	....	.....	.....	.056	14.19	15	1761	. Jaffa.
1016	Valley soil*	Anaheim-Langenberger Vineyard....	Orange	....	Diseased vines..	69.84	11.40	81.24	.80	.32	2.04	1.92	.05	3.16	7.56	.08	.01	......	....	2.70	99.88	.52	.62	.....	.....	...	2.97	16	1016	Morse.

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* This analysis was published in the Viticultural Report for 1886, but has never been tabulated.

Soils Sent for Examination—Continued.

Name.	Locality.	County.	Sender.
Red soils (2)	San Gabriel	Los Angeles	J. R. Abbot.
Dark loam	Long Beach	Los Angeles	Chamber of Commerce.
Alkali soil	Rialto	S. Bernard'o	B. F. Taylor.
Sandy loams (4)	Lamanda Park	Los Angeles	James Craig.
Sandy soils (6)	Redlands	S. Bernard'o	H. Cousins.
Micaceous soils (3)	Anaheim	Orange	J. B. Neff.
Red soil	El Cajon	San Diego	J. T. Gordon.
Soils (13)	Mojave Desert	Kern	Lyman Bridges.
Red sandy soil	Escondido	San Diego	W. D. Wooldridge.
Red valley soil	Escondido	San Diego	W. D. Wooldridge.
Soil	Mentone	S. Bernard'o	P. McPhee.
Sandy soil	Perris	San Diego	Ora Oak.
Soil	Los Angeles	Los Angeles	N. W. Stimson.
Soil	Los Angeles	Los Angeles	E. J. Bowers.
Soil	Los Angeles	Los Angeles	Frank Wiggins.
Soil and subsoil	3 miles S. of Santa Ana	Orange	Dr. Hopkins.
Soils (6)	Perris	San Diego	Ora Oak.
Soils (3)	Perris	San Diego	L. D. Mapes.
Soils (3)	Perris	San Diego	E. E. Waters.
Soils (2)	Perris	San Diego	L. K. Shaw.
Soil	Orange	Orange	J. A. Woolsey.

LATE PROGRESS IN SOIL EXAMINATION.

By E. W. Hilgard.

Read at the Denver meeting of the American Association of Agricultural Colleges and Experiment Stations, August, 1895.

The revival of interest in direct soil examination for practical purposes is fast bearing its fruits in the development of new methods of analysis, as well as of modes of interpretation of the results obtained by former methods; and this movement is no less pronounced in Europe than in the United States. The great difficulty experienced in the practical carrying-out of culture experiments to definite conclusions under any but the most rigorous scientific supervision, is becoming more and more obvious; and so is, correspondingly, the desirability of direct methods for determining the needs of a soil without losing at least one year's time in a culture experiment. It is hardly necessary, at this stage of the discussion, to do more than to recapitulate briefly the points that chemical soil analysis fairly claims to have established in respect to its direct bearing on cultural experience, before discussing those that as yet have not been fully tested.

In the discussion of this subject it is too often forgotten that two entirely distinct questions call for solution by chemical soil analysis. One is to ascertain the total store of plant-food which may become available by the weathering process within periods of time in which we are interested, involving essentially the "durability" of the land. The other is the ascertainment of the plant-food immediately available for the growth of crops. The former aims to determine a maximum; the latter, a minimum. Much discussion has arisen from a confounding of the two problems, which clearly cannot be reached directly by the same means. The determination of immediately available plant-food interests specially the agriculturists of countries long settled; while those intending to settle on new lands, of unknown cultural values, are specially interested in knowing how long it will be before the soil they cultivate will call for fertilization, and when it does, what fertilizers will be needed first.

1. As regards soils in their natural condition there can be no question that an unusually small proportion of any one ingredient important to plant nutrition, indicates that a deficiency in that ingredient will make itself felt, if not at once, certainly within a few years after cultivation is begun, and can be remedied by the use of that ingredient as a fertilizer.

As a corollary to this, those who claim that analysis cannot appreciate the differences caused by the withdrawal of soil ingredients by crops, must admit that the same maxim holds true of soils cultivated for any length of time *without* the addition of any fertilizers. This brings a very large proportion of American lands, now under cultivation, within the pale of those which can be successfully investigated, and, therefore, practically benefited by the lights afforded by soil analysis. Farmers are continually demanding information regarding the special adaptations of their lands; and while these are as much determined by physical as by chemical factors, yet a knowledge of the latter is indispensable to an intelligent judgment.

2. Conversely, any ingredient shown by analysis to be present in very large proportion in any virgin soil, may fairly be presumed to be the last to become deficient under ordinary modes of cultivation.

Both the above propositions not only commend themselves to common sense, but have been over and again abundantly verified in practice; always provided that the analysis has not been made by too incisive a method, and upon an absolutely uniform plan. The ultimate analysis of a soil mass-is, to all intents and purposes, practically worthless; while on the other hand, too light an action, such as that of carbonated water, is equally valueless in presence of the fact that plants themselves have long been known to employ acids exuded from their roots, of sufficient strength to engrave the form of the root fibers upon the smooth surface of calcite, feldspar, and hornblende crystals, in the course of a single season.

The practical utility of the interpretation of soil analyses depends essentially, of course, upon the correct ascertainment of the percentage figures which may be considered as constituting deficiency, adequacy, and abundance of any ingredient. To this I have devoted a great deal of labor, the results of which, so far as then developed, I have given in former publications. It was but reasonable to expect that the figures for the several degrees of deficiency or abundance would not be the same for soils of every class, and I so found it; the most potent determining factor in the premises being lime, actually or virtually in the form of carbonate. The general statement made by me fourteen years ago, that in the presence of abundance of lime much smaller percentages of plant-food prove adequate than when lime is deficient, is abundantly verified by all the work done since, whether by myself or by others; but the causes, according to modern research, are shown to be even more complex than I had foreseen at the time of my former publications. In the course of a closer personal study of the soils of Europe, I have also recognized one reason at least why this dominant function of lime has remained almost unrecognized in the old continent.

This is simply that calcareous formations (including the drift areas) are so predominant in Europe that few soils are what can properly be called non-calcareous—that is, not containing at all times a sufficient excess of calcic carbonate to produce the characteristic important effects upon the soil. With us, such large areas are so deficient in lime in the soil, that the contrast between them and the adjacent calcareous areas becomes patent at a glance. It was this that, in the first place, led me to consider the claims of soil analysis as worthy of any consideration. Added to this accident of the almost uniformly calcareous character of European soils, the fact that only such as had been long cultivated came under the consideration of investigators there, who thus wrestled with the problem in its most complex form, explains very simply the discredit which was there so long thrown upon the very name of soil analysis; a tradition to which some persons on this side of the Atlantic still tenaciously cling, while on the other, that tradition already counts among the "ueberwundene Standpunkte," and the effort to make soil analysis useful to practice is being zealously pursued by many hands.

The most notable utterance on the general subject is that of Professor Liebscher, of Göttingen, in a report of 216 pages on the results of a seven-years' course of culture-plot experiments. He shows the necessity of discussing all such results on the principles of the calculus of probabilities, and by so doing comes to a number of very valuable conclusions regarding the particular soils on which the experiments were made. Further than this the results, of course, cannot go; but Liebscher wisely accompanied his plot-experiments with parallel analyses of the several soils, using the usual method of chlorhydric extraction. Regarding these, he makes at the end of his report the following statement, remarkable as coming from a notable authority who has thus far never said a word in favor of chemical soil-work:

"While reserving detailed discussion for the future, we cannot omit to mention right now that the ordinary analysis of the chlorhydric soil-extract yields much more information than is mostly supposed. In fact, we can deduce the requirements as to mineral plant-food of all the soils we have investigated, from their analysis, coming to the same results as from our culture-tests, by adopting the following points of view in their interpretation." These points of view agree so closely with those heretofore developed by me, in my work on virgin soils, that I cannot but feel considerable satisfaction in seeing them verified for soils long cultivated; a point regarding which I have not expressed any opinion thus far, although convinced that such agreement would be found to exist in the nature of the case.

In the analyses made by extraction with chlorhydric acid, the intention is to extract all that (presumably) will become available to plant-action within any period of time in which we are interested; the aim is to establish a presumable *maximum*. Attempts to ascertain the condition of the soil with respect to *immediately* available plant-food have, as is well known, been numerously made, but have yielded very indefinite results, until within the last few years Dyer attacked the problem by the direct determination of the acidity of the root juices employed by the plant in dissolving its mineral food. When once mooted, the wonder is that this simple, direct appeal to the plant itself has not been thought of sooner, since it has long been evident that this action is much more energetic than that of carbonated water, at first thought to be the chief solvent.

Warington (*Science Progress*, May, 1894) has discussed the imperfections in Dyer's prescription of a one per cent solution of citric acid as a solvent for the supposed available mineral plant-food. Most of these have been foreseen and admitted by Dyer himself, who is still, it is understood, engaged in the investigation of the subject. One of the most serious obstacles to the ready use of Dyer's method, especially in the West, is the presence of earth carbonates, which of course neutralize the citric acid used, to an extent corresponding to the amounts present—which it is not altogether easy to neutralize without risk of increasing unduly the solvent effect, since it is inadmissible to use either heat or a stronger solution to accelerate the decomposition of the carbonates. The only really unobjectionable way seems to be the successive addition of the one per cent solution until neutralization ceases; then, after decanting, adding the required amount of the acid in addition. This is often a tedious operation, especially when the carbonate grains are somewhat large; and thus the use of the method in limestone soils is somewhat inconvenient.

I have, however, tested it on a number of soils containing only small amounts of carbonates, for the determination of the available phosphoric acid, with results agreeing exceedingly well with the cultural experience. In the absence of suitable material for such experiments in as new a State as California, where, moreover, nearly all soils are calcareous as a result of climatic conditions, I have used a number of soils sent from the Hawaiian Islands for investigation as to their needs, they having ceased to produce satisfactory crops of sugar cane.

Most of the soils of the Hawaiian group are the outcome of the decomposition of black, highly ferruginous lavas, under the influence of rather copious rains. The soils so formed are usually of a deep ochreous tint, unless (as is frequently the case) they contain humus enough to obscure the iron tint; which, however, appears plainly on ignition. They would fall under the very indefinite class of "laterite" soils of German authors; but, unlike a great many of the true tropical laterites, the iron taint is in this case so intense, not merely because of fine diffusion, but on account of its exceptionally large amount, which sometimes exceeds 40 per cent of ferric oxid, and is usually in the thirties; while the alumina dissolved in the ordinary chlorhydric extraction is frequently only one third as much as the ferric oxid, though sometimes equal, and frequently far exceeds the carbonate-soluble silica; proving its existence in the form of aluminic hydrate. While mostly supplied fairly with potash, many of these soils are characterized by very small lime-percentages; in view of which I long ago recommended the use of the coral sand from the beaches, with excellent results.

Nearly all these soils showed, by extraction with nitric acid after ignition, ample, and in some cases very large percentages of phosphoric acid. As in several cases the use of phosphates had nevertheless produced good results, I suspected that the phosphoric acid might be rendered unavailable by the presence of so large an excess of ferric oxid; a relation I had previously observed in Mississippi soils, and which is readily intelligible *a priori*. It is strenuously reaffirmed by Liebscher, who, in his recent publication referred to above, mentions specially that the presence of the sesquioxids seems to depress seriously the availa-

ANALYSES OF CALIFORNIA AND HAWAIIAN ISLAND SOILS. By M. E. Jaffa and G. E. Colby.

	California Soils.							Hawaiian Islands Soils.					
								Oahu.			Hawaii.		
	Putah Valley Soil, Solano County—No. 110	Valley Soil, Santa Paula, Ventura County—No. 168	Black Land Soil, Tulare—No. 1167	Granitic Soil, Expt. Station, Amador County—No. 1117	Mesa Soil, Experim't Station, Los Angeles County—No. 1281	Black Adobe Soil, University Gr'nds, Berkeley—No. 1679	Long Cultivated Soil, University Economic Garden, Berkeley—No. 1841	Dark Soil No. 20.	Dark Soil No. 21.	Dark Soil No. 22.	Dark Soil No. 24.	Dark Soil No. 26.	Guava Soil No. 27.
Coarse materials > 0.5mm	--------	3.50	10.60	50.00	10.00	15.00	--------	2.00	2.00	2.50	4.00	3.00	5.00
Fine earth	all	96.50	89.40	50.00	90.00	85.00	--------	98.00	98.00	97.50	96.00	97.00	95.00
Analysis of Fine Earth.													
Insoluble matter	67.33	85.66	62.43	77.11	67.98	54.50	--------	16.60	15.84	14.49	26.99	28.66	21.07
Soluble silica	3.67	1.85	16.99	5.40	9.51	19.00	--------	14.37	14.07	30.37	10.26	7.35	2.68
Potash (K_2O)	.93	.63	1.09	.35	.93	.73	--------	.66	.45	.26	.40	.61	.44
Soda (Na_2O)	.12	.07	.77	.17	.42	.20	--------	.09	.14	.08	.26	.17	.25
Lime (CaO)	.77	.76	1.46	.37	1.75	1.15	--------	.56	.26	1.04	.52	.68	.28
Magnesia (MgO)	2.29	.59	1.44	.37	.82	1.08	--------	.76	.65	.80	.96	1.04	.60
Br. ox. of manganese (Mn_3O_4)	.11	.03	.06	.09	.05	.04	--------	.04	.05	.03	.21	.20	.07
Peroxid of iron (Fe_2O_3)	8.01	3.35	4.98	2.93	7.07	8.43	--------	40.00	39.05	19.68	19.10	18.23	30.10
Alumina (Al_2O_3)	9.16	3.10	6.87	7.27	7.72	7.92	--------	12.64	14.61	18.29	21.41	20.18	14.38
Phosphoric acid (P_2O_5)	.11	.20	.12	.04	.20	.19	--------	.16	.19	.32	.64	.70	.97
Sulphuric acid (SO_3)	.12	.01	.02	.02	.03	.04	--------	.04	.03	.09	.32	.21	.29
Water and organic matter	7.12	3.13	4.36	6.09	3.49	6.54	--------	14.30	14.18	14.59	18.60	21.65	28.60
Totals	99.74	99.38	100.59	100.21	99.97	99.82	--------	100.22	99.52	100.04	99.67	99.61	99.73
Humus	1.71	.84	1.33	.80	.58	1.20	1.65	3.33	3.35	3.24	4.84	5.43	9.95
Humus ash	--------	--------	.36	.31	.26	.94	--------	3.90	3.12	2.22	2.76	3.56	6.70
Phosphoric acid	--------	--------	.01	.02	.02	.04	--------	.074	.11	.166	.58	.50	--------
Silica	--------	--------	--------	--------	--------	--------	--------	.650	.78	1.100	.76	.84	--------
Nitrogen in 100 of humus	4.250	7.990	18.190	15.270	15.500	18.580	3.400	3.550	3.300	9.800	2.800	3.100	1.710
Nitrogen in 100 of fine earth	.072	.067	.302	.123	.090	.203	.056	.118	.112	.314	.134	.168	.170
Phos. acid, soluble in nit. acid (sp. gr. 1.20)	.110	.200	.120	.040	.200	.190	--------	.160	.190	.320	.640	.700	.970
Soluble in hydrochlo. acid (sp. gr. 1.115)	--------	--------	--------	--------	--------	--------	--------	.320	.430	.350	1.600	1.280	--------
Soluble in 2 per cent citric acid	.040	.062	.062	.006	.054	.033	--------	.004	.004	.020	.035	.037	.025
Hygroscopic moisture (absorbed at 15° C.)	10.32	5.49	5.38	3.27	1.98	11.98	--------	19.66	18.50	21.25	23.07	23.14	23.81

bility of the phosphoric acid of the soil, because of the insolubility of their basic phosphates in the dilute vegetable acids of the roots.

As these Hawaiian soils seemed to offer an exceptionally good opportunity for testing this question, the determination by nitric acid in the ignited soil was supplemented by one made with chlorhydric. This treatment, as might be anticipated, gave a very much higher phosphoric acid percentage in most of the samples, since crystalline vivianite will dissolve in chlorhydric acid as well as the gelatinous basic, ferric phosphate; for which reason I have discarded its use in the determination of phosphoric acid for the practical purposes of soil analysis. The same objection lies, of course, against the use of concentrated sulphuric acid, proposed by Goss. In either case, the results are simply obscured by the mass of inert matter brought into solution.

The table herewith exhibits these results, together with those obtained on some California soils. Among the latter is one (No. 1117) notably deficient in phosphoric acid, both from the analysis and from culture tests; while the rest are all from fresh, if not virgin, ground, and stand in no present need of fertilization, judging from their profuse productiveness.

Keeping in mind that such figures as 6 and 8 in the third decimal place mean a deficiency of available P_2O_5, according to Dyer's results, the lesson taught by the figures in this table explains itself. In the highly productive virgin soils of California, the citric-soluble (P_2O_5) has ranged from .033 to as much as .063; while in the "phosphate-hungry" soil (No. 1117), .006, or from one fiftieth to one tenth as much only, appears. In the case of the Hawaiian soils the showing is equally cogent; of those from Oahu, Nos. 20 and 21 were reported as giving poor crops with the same amounts of phosphates that gave a satisfactory crop on No. 22, which contains four times as much of the easily soluble form. Nos. 24 and 26, from Hawaii, do not as yet show a very serious decrease in crop production, but it was desired to know where trouble was likely to arise. Here the phosphates are probably not concerned as yet; and I was led to investigate specially the cause of the deficient production in the case of No. 27, which bore two fair crops and then utterly refused to grow the cane to maturity.

I suspected that notwithstanding the high humus-percentage of this soil there might be a deficiency of available nitrogen, and therefore applied to it the clew previously obtained from the investigation of the nitrogen-percentages in the soils of the arid and humid regions (*Agr. Sci.*, April, 1894), which pointed to the much greater ease with which humus of high nitrogen-percentages can be nitrified in the soil. Conversely, it was predicable that whenever that percentage falls below a certain point, nitrification will be too slow to supply the needs of a growing crop.

THE RECOGNITION OF "NITROGEN-HUNGRINESS" IN SOILS.

The determination of nitrates and ammonia salts in soils ordinarily conveys little information concerning their resources in nitrogen for plant supply. A soil may, at certain seasons, be found totally wanting in these compounds, and may yet be able to yield to crops under proper conditions all the nitrogen required. So variable and minute are the amounts of these compounds usually present, that their determination is mostly of little practical interest.

The permanent or "reserve" supply of soil nitrogen is unquestionably that contained in the humus, in the (supposed) amidic form, which is gradually made available by the nitrifying organism, when the favoring conditions of moisture, warmth, and access of oxygen are fulfilled, in connection with the neutral (or basic) condition of the soil, due to the presence of an excess of earth carbonates.

It is *a priori* probable that the composition of the complex and indefinite substance we call "humus" must exert a material influence on the rate of nitrification. It is known that when it is in an acid condition, nitrification is almost null. It seems at least likely, that the process is also affected by the richness of the humus in nitrogen, which has all along been known to be indefinite, but has usually been assumed to range from about 3 to 5 per cent.

I have in former papers called attention to the fact that the only reasonably reliable method for the determination of true humus in soils is that of Grandeau, viz., extraction of the humus with weak alkaline lye, after setting it free from its earth combinations by treatment with weak HCl. All combustion methods, whether in the wet or in the dry way, as well as extraction with *strong* lye, yield utterly indefinite results on account of the simultaneous combustion or dissolution of unhumified matter, varying with the seasons and the crop. It is only with the substance ("matière noire") extracted by Grandeau's process that definite and consistent results can be obtained.

In the paper quoted above, and in the report of this Station for 1894, I have given a summary of the results of investigations made by Jaffa and myself on the marked differences in the nitrogen-contents of humus in the arid and humid regions; showing that while in the soils of the latter the average percentage is less than 5, and rarely exceeds 6, in arid soils the average percentage is over 15, and in some cases approaches 19, being several per cent higher than in the albuminoids.

During the past year the following additional analyses have been made:

Soil Number	Character of Soil.	Locality.	Humus—Per Cent in Soil	Nitrogen—Per Cent in Humus	Nitrogen—Per Cent in Soil
		Uplands—California.			
6	Black adobe	Stockton, San Joaquin County	1.05	18.66	.196
1679	Black adobe	University grounds, Berkeley	1.20	18 58	.203
1842	Black adobe	Ramie plot, Economic Garden, Berkeley	1.80	4.17	.075
1841	Black adobe	Exhausted soil, Economic Garden, Berkeley	1.65	3.40	.056
1147	Adobe soil	Experiment Station, Paso Robles, San Luis Obispo County	.47	16.18	.074
1538	Mesa soil	Experiment Station, near Chino, San Bernardino County	.65	16.08	.105
		Lowlands—California.			
1636	Red soil	Manton, Tehama County	2.00	6.86	.137
1704	Valley soil	Hollister, San Benito County	.94	5.21	.049
1714	Bench soil	Piru Ranch, Ventura County	.78	9.56	.074
774	Bench soil	Ontario, San Bernardino County	1.29	10.85	.140
1758	Alkali soil	Perris Valley, Riverside County	.60	6.83	.041
1759	"Alfileria soil"	Perris Valley (higher land), Riverside Co.	.53	11.04	.059
1760	"Green sage land"	Perris Valley, Riverside County	.91	7.70	.070

Additional Analyses—Continued.

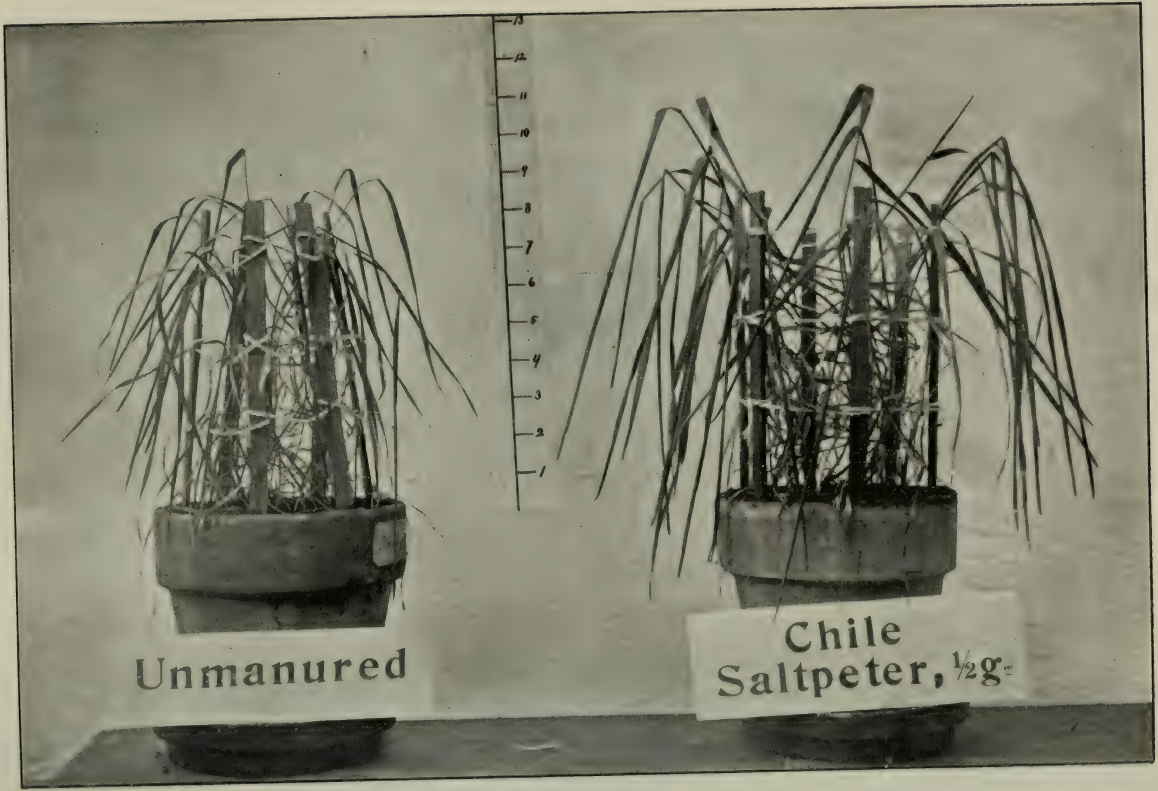
Soil Number.	Character of Soil.	Locality.	Humus—Per Cent in Soil.	Nitrogen—Per Cent in Humus.	Nitrogen—Per Cent in Soil.
		Oregon.			
	Duff soil		13.84	3.49	.483
		Hawaiian Soils.			
10	Red soil (old)	Kauai Island	7.80	2.93	.229
11	Dark soil	Campbell's plantation, Oahu	1.08	6.58	.072
18	Dark soil	Oahu Island	3.53	2.50	.089
20	Dark soil	Oahu Island	3.33	3.55	.118
21	Dark soil	Oahu Island	3.35	3.30	.112
22	Dark soil	Oahu Island	3.24	9.80	.314
23	Red soil	Oahu Island	1.57	5.07	.078
28	Light-colored soil (old land)	Maui Island	7.23	3.10	.224
29	Dark soil (new land)	Maui Island	10.90	3.15	.347
24	Dark soil (10 years in use)	Hawaii Island	4.84	2.80	.134
25	Subsoil	Hawaii Island	4.48	2.54	.114
26	Dark soil (new)	Hawaii Island	5.43	3.10	.168
27	Guava soil	Hawaii Island	9.95	1.71	.170

It can hardly be doubtful that such differences in nitrogen-contents must materially influence nitrification. The nitrifying organism requires oxygen to accomplish its life-process. The supply of that element in the soil is limited, and if in one case 19 out of 20, in the other case only 4 out of 5 parts of carbohydrated substance have to be oxidized away to get at 1 part of nitrogen, it can be hardly doubtful which will lend itself more readily to the nitrifying process. As a matter of fact, the constant occurrence of nitrates in the soils of the arid region, poor as they usually are in humus, establishes this presumption *a priori*.

In view of these facts, it seems highly probable that *there is a certain minimum of nitrogen-percentage in humus below which the nitrifying organism will be incapable of sufficiently intense action to supply the current demands of crops.* If this be true, then we have in the determination of the nitrogen-percentage of humus the means of determining whether or not a soil is in need of a supply of available nitrogen for crop production—whether or not it is "nitrogen-hungry."

Among the California soils given in the above table, the most striking example is that of No. 1679, one of those showing an unusually high nitrogen-percentage in its humus (18.6 per cent). Alongside of it, soil No. 1841, taken within fifty feet of the other sample, but kept in grass, unmanured, for about ten years and lately dug up because of unsatisfactory growth of the grass, shows with a higher humus-percentage a much lower proportion of nitrogen; proving strikingly the depletion caused by exhaustive cropping.

In another plot of the same soil, which had been set in ramie for about ten years, the nitrogen-percentage was found to be reduced to 5 per cent. A similar relation is shown between the two old soils of the Oahu Island, and the relatively fresh one (No. 22), where the ratio is



Experiment on Wheat, With and Without Nitrates.

as one to three. Of the soils from the Hawaii Island, the first two (24 and 26) are just a little below the Oahu soils in the nitrogen-percentage of the humus, although the totals of both humus and nitrogen in the whole soil are higher. But in the case of No. 27, while the humus-percentage is nearly double that of the other two, the nitrogen-content of that humus, 1.7 per cent—the lowest that has come under my observation thus far—was almost virgin land, just cleared of guava brush, but had borne one good crop of sugar cane, and one fair one of ratoons. The third year the cane, freshly planted, refused to grow after having exhausted the seed-cane; and, from the symptoms reported, I was inclined to diagnose deficiency of nitrogen before the humus determination was made.

Having previously come to the conclusion that any soil containing humus with much less than 2.5 per cent of nitrogen was to be suspected of "nitrogen-hungriness," and, notwithstanding that the total nitrogen-percentage in this soil (.17 per cent) might be considered a high one, I recommended the use of nitrogenous fertilizers; and also made a pot-culture experiment with the same soil, using about a kilogram in each pot, and fertilizing one with half a gram of Chile saltpeter.

The subjoined photograph shows the result of this experiment at a time when there was an overwhelming attack of mildew (*Puccinia graminis*), which, despite vigorous sulphuring, finally killed the plants. There can be no question of the result, as showing deficiency of available nitrogen. According to late information from Hawaii, corresponding results have been obtained in the field with cane, manured with Chile saltpeter, notwithstanding the fact that an unusually wet season was most unfavorable to the efficacy of that salt.

I think, therefore, that I am justified in indulging the hope that we are on the trail of a method for the definite ascertainment of the condition of a soil as to available (non-nitric) nitrogen, which, with the method of Dyer for the corresponding determinations with respect to potash and phosphoric acid, when all are perfected, would effectually solve the problem of the manure requirements of cultivated soils that has so long resisted the efforts of chemists. There can be no doubt that differences in the other soil ingredients will influence the lower limits of each of the three primarily important substances; more especially will the presence or absence of an adequate amount of lime to keep the soil in a non-acid condition, and to perform the many other important functions of that base, be doubtless found very important. The observation alluded to above, as the result of numerous comparisons of soil composition with agricultural practice, *that in presence of much lime a smaller percentage of the several mineral ingredients will be found necessary*, seems to hold true in respect to nitrogen from the data already obtained. That this is likely to be so might be predicted from the well-known favorable effect of lime on nitrification; and the figures appear to indicate as probable that in soils poorly supplied with lime the limit of "nitrogen-hungriness" lies rather above 2.5 per cent of nitrogen in the soil humus, while in calcareous soils it lies below that figure for grass crops on soils otherwise fairly conditioned.

It is predicable that no definite figure can be assigned that would be valid for all crops and soil conditions. The richness of the humus in nitrogen is but one of the several factors that contribute to ready nitrification; porosity and temperature as well as moisture conditions will make their influence felt, and it is thus probable that in relatively cold, close soils, and in cold climates, a higher nitrogen-content is required for ease of nitrification, than where warmth and porosity concur in favoring the action of the nitrifying bacteria. Again, different crops will require a different rate of nitrogen-supply. Here, as in the rest of the problem of predicting the qualities of soils, no mechanical, or mere sliding scale, requiring no effort of the intellect or judgment, will be likely to suffice, but a number of points will have to be conjointly considered. Admitting all these difficulties, it will be no inconsiderable advantage to find in this method an approximation to the problem of a soil's requirements in nitrogen, as we have in Dyer's methods an extremely useful index of the soil's needs in respect to potash and phosphoric acid. While in all cases the pot or field test will have the last word, yet the simplification and directness introduced into them by the previous determination of the prominent features of the soil by chemical means, is so great and palpable an advantage, and so clearly in line with the recognized methods of inductive investigation in all other lines, that its omission is hardly excusable.

THE SUPPLY OF SOIL NITROGEN.

By E. W. Hilgard.

Abstract of lecture delivered at Farmers' Institute at Monrovia, Cal.

It has been well said that at this time, one of the chief problems of agricultural chemistry is the cheap conversion of the nitrogen gas, which constitutes four fifths of our atmosphere, into a form available for the fertilization of land. For, abundant as is this substance in nature, its restoration to soils exhausted by cropping is as yet the most expensive return which the farmer has to make. The supplies of the other two chief ingredients of fertilizers—potash and phosphoric acid—are relatively abundant and on the increase; but as yet we know of no source of nitrogen that promises to reduce materially its cost to the farmer, which is now over three times that of either of the two others per pound. The prospect that within a short time the entire nitrate deposites of Chile will be in the hands of a syndicate which can exact "all the traffic will bear" for Chile saltpeter, renders the question of nitrogen-supply to soils doubly interesting to the farmer at this time. Frequent questions addressed to the Experiment Station on these points render it desirable that the results of some work lately done in this line should be briefly noticed.

It has been known for some time that while the larger number of our cultivated plants, and among them particularly the grains, must derive all the nitrogen they need from the small store in the soil (where it is contained in the "humus," or black mold), there is one group of plants which not only do not impoverish the soil in nitrogen, but on the contrary, if used for green-manuring, add materially to its store, so as to replenish the supply when required for grain culture. It is the plants comprised within the pea family (leguminous plants, or "legumes"), embracing the pea, beans, clovers, vetches, lupins, etc.; also the acacias and related trees. Hence the clovers have from time immemorial been used for land improvement; while, where the climate is unfavorable to these, other plants of the same family have been substituted for them. In this State, where alfalfa is the general substitute for clover, the difficulty of plowing-in a well-set alfalfa crop, and of getting rid of it when a clean field is wanted for other crops, has stood in the way of this very needful means of supplying the land not only with nitrogen, but also with humus, so necessary as a general soil-ingredient and so commonly deficient in the lighter class of California soils used preferably for fruit culture. The growing of green crops *not* of the leguminous tribe, merely for the sake of supplying humus, and returning only what was taken from the soil, has usually proved an unprofitable investment.

Until within a few years the cause of the peculiar ability of the legumes to take nitrogen from the air during their growth was not understood. It is now known that it is accomplished through the agency of one of the many minute organisms called bacteria, which produces knotty excrescences on the roots of these plants that swarm with these minute organisms which take up nitrogen directly from the air, while the plant in its turn takes it from them for its own purposes. These root excrescences or tubercles may be easily observed by any one making a careful examination of the roots of clovers or peas while in growth. These are further described and illustrated, under the head of Green-Manuring, in this report.

For a number of years past the Station has been making observations on plants suitable to this climate that should combine the needful qualities for green-manuring in place of clover. This is of especial interest in the case of orchards, in which it has often been noted that after having been kept completely free from weeds for a number of years, their production decreases in a marked degree, despite of fertilization, while at the same time the soil is difficult to keep in good loose tilth.

At first it was hoped that among the native clovers and lupins some might be found suitable for the purpose, but thus far the burr clover—a foreign immigrant—has seemed to answer better than any of these; an objection being, however, that it yields but a relatively small amount of herbage, and is apt to remain as a troublesome weed.

This season, in examining a number of foreign legumes grown in the University Economic Garden, two were found whose roots are fairly incrusted with tubercles, implying a very rapid absorption of nitrogen from the air. One of these has been so far investigated as to render it a hopeful subject for trial on the large scale, and all available seed has been sown in order to produce a supply for distribution next winter. Experimental plots have also been sown at each of the four culture substations, so as to test the plant in their several soils and climates this season.

So far as the small-scale test shows, this plant combines the advantage of quick development (being an annual) with an unusually heavy production of herbage; the latter having, in two different plots, been at the rate of 24 and 26 tons per acre, equal to about 5 tons of air-dried hay. While its nitrogen-percentage is not as high as that of alfalfa or clover, its aggregate nitrogen-product would nevertheless be considerably greater than in the case of alfalfa, and more than twice as great as with burr clover.

This plant having no common name, and its botanical name of *Tetragonolobus purpureus* being rather too intricate for common use, I propose to call it the "Square-pod pea"; its pod being four-sided, and winged. It is a native of Southern Europe, where it is grown for ornament, and also for the use of the green pods as a salad. Its taste is agreeable, and would doubtless suit the palate of cattle as well as that of man. The plant is described and illustrated in this report, under the head of Distribution of Seeds, Etc.

Further experience, however, must be awaited to determine its suitableness for the requirements of practice. While it produces seed abundantly, the peas are rather large—about like sweet-pea seed—and may be somewhat costly when a heavy stand is wanted for green-manuring, at the rate above mentioned. But it would seem that if sown in January, it would be ready to be plowed-in about the middle of May.

Much has of late been said about the mistaken policy of direct green-manuring, in place of feeding the fodder to stock and using the manure produced. This is all right when cattle are at hand, and manure can be made; but the fruit-grower, at the present time, cannot make this combination in most cases, and thus far the methods of manure preservation are commonly so far from perfect that, as matters stand, he will usually find it more profitable to plow-in the crop for the benefit of his main product.

Another point of interest in connection with the supply of soil-nitrogen in the arid region has lately been developed by the work of the Station. It having been observed that the light sandy or powdery soils, so characteristic of our fruit-growing mesas, are very poorly supplied with humus, the natural inference was that since humus is the repository of the soil-nitrogen, these soils were poor in that essential ingredient. A further inference was that when these otherwise rich soils began to fall short in production, nitrogenous fertilizers were first in order. The recommendations made accordingly, having in a number of cases failed to produce a satisfactory result, the cause was sought for. Investigation revealed the entirely new fact that *the humus of the arid soils contains, on the average, more than three times as much nitrogen as does that of the region of summer rains;* and that, therefore, the supply of soil-nitrogen is very nearly the same in both regions. This fact has very direct practical bearing upon the most profitable manner in which the farmer may apply what money he spends for fertilizers; for it is obvious that he should first supply that which is immediately needed, and not those ingredients of which there is a surplus in the soil.

A notable example in point has just come under observation. Owing to the deficient rainfall in Southern California, alkali salts have appeared on the surface at numerous points where ordinarily none are seen, and injury has been done to certain crops quite unexpectedly. Such was the case at some points on the experimental tract of ten acres on the Chino Ranch, right where some of the richest sugar beets have been grown and where the same crop now shows up in excellent condition. It was thought interesting to examine the alkali that made such a marked exception in favor of the sugar-beet crop. It was found that the first foot of soil from the surface averaged three tenths of one per cent (.33 per cent) of soluble salts, which, as usual, rise to the surface, and accumulating there, may damage especially young seedling plants.

Analysis revealed the surprising fact that while the bulk of the soluble salts or alkali consists of the usual ingredients, common salt, and

Glauber's salt or sulphate of soda ("white alkali"), no less than 12 per cent consists of Chile saltpeter (nitrate of soda). Calculating this to the usual weight of an acre of such soil to the depth of one foot—three and a half millions pounds—we find that this mass of soil contains no less than 1,400 pounds, or nearly three fourths of a ton, of Chile saltpeter. This, at 4 cents per pound, the usual price, represents the handsome sum of $56 per acre in Chile saltpeter alone. While we may still wonder that so heavy a dose of this fertilizer should, in California, permit of the production of the very highest grade of sugar beets, while in Europe its use is closely limited for fear of deterioration of their quality, we may at the same time congratulate ourselves upon the extraordinary fund of fertility existing in such lands, which seems to postpone indefinitely the necessity of the replacement of nitrogen withdrawn by crops. For what is contained in the first foot of soil is but a portion of what we may fairly presume to be present in the entire soil-mass reached by the tap-roots of the beet; and at the same time, the supply is being constantly replenished by natural processes.

It will hardly be contended in the face of such facts as these, that the farmer should blindly follow the invitation of some fertilizer manufacturers to use "complete fertilizers" without regard to the nature of the soil or crop. Coal has, in this century, been carried to Newcastle, but it was not done for the benefit of the coal-miners.

INVESTIGATION OF MATIÈRE NOIRE, OR HUMUS.

By M. E. Jaffa.

We are sorry that we cannot present with this report a complete investigation of humus. But owing to the large amount of routine work which had to be attended to, there was no time to do more than to commence the work in this line. One kilogram of the University soil, after being leached with weak chlorhydric acid, was extracted with pure ammonia water 6 to 7 per cent strong, and the extract dried at 100° C. The amount of humus, or matière noire, so obtained is about 20 grams. The substance consists of small, irregular particles, jet black in color, metallic luster in part, with brownish streak. It contains about 22 per cent ash and more than 10 per cent nitrogen. A complete analysis of this material will be made during the coming season, and the results given in our next report.

METHOD FOR DETERMINATION OF NITROGEN IN HUMUS.

Two portions of 5 or 10 grams of air-dried soil (depending on richness in humus) are weighed off into prepared filters (about 9 cm.). The soils should be covered with filter paper, so as to prevent packing when solvents are poured on them.

They are now treated with dilute hydrochloric acid, from .5 to 1 per cent strong (25 c.c. concentrated acid to about 800 c.c. water), to dissolve out the lime and magnesia, which prevent the humus from going into solution with alkali hydrates. The treatment with acid is continued until there is no reaction for lime; the acid is then washed out with water to neutral reaction. The funnels (7 cm.) containing the washed soils are now stoppered (either with a cork or by means of a small piece of rubber tubing with glass plug), and one of them is treated with ammonia water 6 to 7 per cent strong, for the determination of humus, and the other with potassic hydrate 5 per cent strong, or sodic hydrate 4 per cent, for the estimation of the nitrogen. The mode of operation is the same in both cases, so far as the extraction of the humus is concerned. The lye, ammonic or potassic, is poured on the respective funnels and allowed to remain a few hours (if started late in the afternoon the liquid can remain in funnel all night). The solution is then allowed to pass through, and the filter washed once with the lye; the funnel is then restoppered and a fresh quantity of the solvent added to the filter. This treatment is repeated until the filtrate remains colorless.

The *ammonia solution*, or an aliquot of the same, is evaporated in a weighed platinum dish, over the water bath, and the residue dried at 100° C., and weighed. It is then ignited and reweighed; the loss in weight shows the amount of humus. It is rarely necessary to recarbonate the ash.

The *potassic or sodic hydrate solution* is measured, and if much over 100 c.c. is best divided into two equal parts; if over 200 c.c., into three equal parts, etc., adding water if necessary, to render aliquoting simple. We now take one half or one third, etc., as the case may be, and transfer to Kjeldahl flask, acidify with pure concentrated sulphuric acid, and boil down until nearly all the water has been evaporated. The flask is then cooled, and sufficient sulphuric acid and mercuric oxid are added to determine the nitrogen in the usual way by the Kjeldahl method. In the distillation, 10 to 20 c.c. tenth normal hydrochloric acid is used in the receiver with methyl orange as an indicator.

Each c.c. of acid used is equivalent to .0014 grams of nitrogen. The percentage of nitrogen in the soil calculated on the percentage of humus in the soil gives the nitrogen in humus.

Note.—Sodic hydrate is preferable to potassic, as sodic sulphate (formed in the flask) is less liable, owing to its greater solubility, to "bump" during the boiling-down with sulphuric acid, and the subsequent oxidation.

II. ALKALI AND ALKALI SOILS.

THE DISTRIBUTION OF THE SALTS IN ALKALI SOILS.

By E. W. Hilgard and R. H. Loughridge.

As time progresses the importance of the alkali question, *i. e.*, of dealing successfully with the cultivation of lands more or less impregnated with soluble mineral salts, becomes more and more obvious. It is to be greatly regretted that the frequent mistaken efforts of landowners to suppress, or at least to ignore, this matter for fear of injuring the selling value of their lands, interpose additional difficulties in dealing with an intrinsically sufficiently difficult problem. In view of this circumstance, we bear patiently the disappointment we have undergone in finding that, unexpectedly, one of our geographically most important culture experiment stations is almost wholly located upon ground subject to the difficulties inherent in the cultivation of alkali land ; since we are thus enabled to study the problem independently of any private interests.

The culture experiment station near the town of Tulare, originally intended to represent the upper San Joaquin Valley at large, has thus, instead, become the Station for the study of the alkali problem in all its phases, from the mildest to the worst. Until this problem is solved, no certain conclusions for the region at large can be drawn from the cultural results observed there, since we now know that all the vegetation on the Station grounds is under more or less stress from the alkali in the soil. If, however, we shall be successful in overcoming this influence, as we hope to be, the Station will have rendered, not only to the San Joaquin Valley and the State at large, but also to the entire region west of the Rocky Mountains, a most important service.

NATURAL CONDITION OF THE LAND.

For an understanding of the situation, it may be necessary to re-state here, that in their *natural condition* the lands of the Station, and for several miles around, as in hundreds of localities elsewhere in the valley and the State, show only occasional alkali spots ; while outside of these spots, during the spring months, the country is covered with a luxuriant growth of native (largely annual) herbaceous plants, many being showy flowers and affording a most attractive sight ; also proving beyond question the great inherent fertility of the land. As the season advances, from April to June, these plants go to seed or dry up, leaving the land more or less bare, or with only a sparse growth of hardy, drought-resisting, partially perennial plants. There is not, in ordinary seasons, any perceptible increase or decrease in the area of the interspersed alkali spots.

When such land is put under cultivation *without* irrigation it will, in years of unusual moisture, bring very heavy crops of grain; which easily make up for at least *one* other season of almost total failure, when the rainfall is light or unfavorably distributed. It is this "fighting chance" of a highly remunerative crop that has in so many cases induced the investment of entire fortunes in such ventures, frequently with a total loss, and financial ruin as the result; a kind of agricultural gambling, little better in itself, and with as many chances against success, as that at the faro table, but now happily almost a thing of the past.

BEHAVIOR UNDER IRRIGATION.

With the advent of the irrigation ditch, the heavy grain crop becomes for a few years a matter of certainty. Then there is a gradual change for the worse. First it is noticed that the alkali spots increase their area outward, often merging neighboring small spots into one large one. Then new ones begin to appear, at first "no larger than a man's hand," but enlarging each year, and finally often so cutting up and reducing the producing area, that the land is abandoned in disgust.

The "rise of the alkali" thus brought about by irrigation was very generally at first attributed (and sometimes justly) to the saline character of the irrigation water used. But as in time it became apparent that even the purest waters, such as those of Kings and Kaweah Rivers, would produce the same result, the conclusion that the alkali salts are simply brought up by evaporation from the soil itself, forced itself upon the most superficial observers.

THE QUESTION TO BE SOLVED.

Then arose the question, "How much of these salts does the soil contain, or where do they come from?" If it could be shown that the soil, subsoil, and substrata were equally impregnated with alkali, and would continue to supply indefinite amounts thereof, the reclamation of such lands for permanent cultivation would be almost hopeless.

We at first approached the problem by the examination of "bottom waters" in cases where the latter had risen from a considerable depth, in consequence of a filling-up from leaky ditches. It was found that, in the vast majority of cases, such water contained relatively small amounts of alkali salts only; not more than many waters successfully used for irrigation elsewhere. It thus became evident that the *main mass of these salts exists in the soil and subsoil within a short distance of the surface.* The chemical examination of the "alkali," moreover, showed that it consists, as a rule, of such compounds as are known to be formed in *all* soils in consequence of weathering; and that it contains *all* the ingredients *useful*, as well as those *useless*, to plant-growth; substances which in rainy countries are currently leached out and carried into the country drainage and finally into the ocean, but which in regions of scanty rainfall remain in the soil-mass.

We are thus led to the vitally important conclusion *that the amount of the salts in these lands is but limited;* and that if once removed, or rendered innocuous to crops in some other way, it will take thousands of years in the future, as in the past, before another such accumulation can occur from the very gradual weathering of the soil-mass.

In view of the extraordinary intrinsic and permanent fertility of alkali lands when once reclaimed, it has seemed desirable to study in detail the manner of the distribution of the soluble salts, as well as their kind, at different depths in the soil and at different seasons; so as to gain an insight into their migrations and transformations, and thus to determine the best and cheapest methods of dealing with them.

The problem is a very complex one, and involves a great deal of labor; hence cannot be solved in one or a few seasons, because of the great diversity of soil-conditions in different localities. The investigation has already, however, yielded such striking and practically important results that it seems best to bring them to public notice at once.

Examination of Soil Profiles and Representation of Results.

The obvious mode of determining the points in question was to sample and examine the soil and subsoil at regular intervals of depth, in spots representing the land in its natural (unirrigated) condition on the one hand, and in the irrigated and cultivated on the other; tracing the effects of the latter conditions so definitely as to be enabled to control, and repress them where desirable, at the proper times and by suitable means.

As will be seen on the face of the plates below, the samples were taken (by means of a post-hole auger) so that each represented a vertical column of three inches of soil; continuing thus to the depth of two to four feet. Each of these samples was then leached of its salts, and every leaching analyzed separately. It was at first attempted to leach only the average of each foot, but this proved quite unsatisfactory, because of the rapid changes occurring at small intervals. In boring, it was noted that while the auger sometimes penetrated with great ease at first, beyond there was a marked increase in resistance, requiring the operator's full weight to rest on the auger in order to make headway. Then sometimes the auger suddenly dropped through into soft, sandy material, very easy to penetrate.

The results of analyses are given in figures in the tables, but for more ready understanding they are also platted, so as to show by means of curves, or lines drawn from point to point of actual determination, the increase and decrease of the total soluble alkali, as well as of the several salts composing it. In the diagrams the depths are shown by horizontal lines at intervals of three inches, as marked on the margin to the left; while the unbroken *vertical* lines represent differences of either .02 or .04 of 1 per cent in the saline contents of the soil-layers, as marked at the top of the diagram, and increasing from left to right.

Inasmuch as each sample represented the average of three inches of soil in vertical depth, in drawing the connecting lines or curves the result of the analysis is assumed to represent the middle portion of each three inches. Hence, the changes of direction always appear as occurring in the middle, vertically, of a three-inch space. The area embraced between each curve and the vertical line to the extreme left represents, of course, the aggregate amount of each ingredient enumerated, viz., common salt, Glauber's salt, and sal soda, as the chief ones, with Chile saltpeter (nitrate of soda) also mentioned, on account of its fertilizing value, where present in notable amounts. The potash compounds, usually constituting from 3 to 7 per cent of the salts, are not shown separately, being included in the "Alkali Sulphate" curve.

The predominance of carbonate of soda seen in these diagrams shows at once that the Tulare alkali is very "black," so that the use of gypsum to change the carbonate into sulphate is the first thing needful in attempting any reclamation or preventive measures. But aside from this, the diagrams suggest, very instructively, the explanation of many points not well understood heretofore.

EFFECT OF THE RAINFALL.

It is well known to residents that in Tulare and northern Kern Counties the greatest depth to which the soil is wetted by the winter rains rarely exceeds three feet. This, then, is the depth to which the soluble salts in the soil may be washed each successive year by the natural rainfall; and from this depth it may partially or wholly reascend toward or to the surface by evaporation during each dry season. It is reasonable to expect that near the lower limit there will be a gradual accumulation of the saline matters, which reach it from above in the form of strong solutions.

Plate 1 illustrates this strikingly. It shows the condition of the natural, unirrigated land at a point half a mile north of the Experiment Station, which was at the time (May 3, 1895) covered by the native spring growth of herbage and flowers, and which during the dry season shows no sign of alkali on the surface. Evidently, at the time represented here the winter rains had washed the alkali salts so far from the surface down into the subsoil, that the seeds had no difficulty in germinating near the surface; and as the growing herbs covered the ground, practically *all* the evaporation took place through the roots and leaves, and hence the alkali did not move upward to any great extent. The bulk of the roots only reached to the level (18 to 24 inches) where the impregnation is not strong enough to hurt them. The soil moisture in this upper layer being pretty nearly exhausted by the evaporation *through the plants* during their growth, evaporation from the soil itself could not, thereafter, bring any perceptible amount of salts to the surface. Thus the first rain would, next season, again enable the seeds to germinate without injury from the alkali, despite the heavy impregnation farther down; which is seen, in this case, to be greatest about the second half of the third foot.

As a matter of course, not only the native growth, but also any *crop* of which a good stand has been obtained on an alkali soil, will similarly tend to diminish or prevent the rise of the alkali. Hence a crop of alfalfa, once established, may flourish for years on ground that, so soon as it is left bare during the dry season for the fall sowing of a grain crop, may prove altogether too strong near the surface, and may kill the grain.

From about the 35-inch level down we see a sudden and very rapid decrease of the salts, so that toward the end of the fourth foot they are reduced to little more than is shown at the end of the first foot from the surface.

Those familiar with "black alkali" lands in the upper San Joaquin Valley will at once recognize the three-foot depth as the one at which, in punching, or in digging post-holes or ditches, a very tough, intractable, clay hardpan is frequently encountered, which, when exposed to the air, soon becomes covered with abundance of white salts. This is the cause of the thick, loose layer of salts often seen alongside of irrigation ditches in the alkali regions.

We see thus demonstrated, beyond any possible cavil, the correctness of the conclusion we have previously drawn from the examination of the bottom waters, viz.: that *the bulk of the alkali salts is, even in natural alkali lands, accumulated within easy reach of the surface and of underdrains;* and that, *if this accumulation is once removed, no more, or at least not enough to do any harm, will come from below.* This points to *underdrainage* as the ready and complete corrective of all alkali, as has been long ago recommended by us.

But it does not therefore follow that the indiscriminate use of underdrainage is to be recommended, since, as we have abundantly shown, enormous amounts of valuable soil ingredients would thus run to waste. In the majority of cases other means, presently to be referred to, will accomplish the reclamation.

The accompanying table No. 1 gives the actual amounts obtained by analysis, and also the percentage of each ingredient with reference to the total amount of alkali salts in each sample.

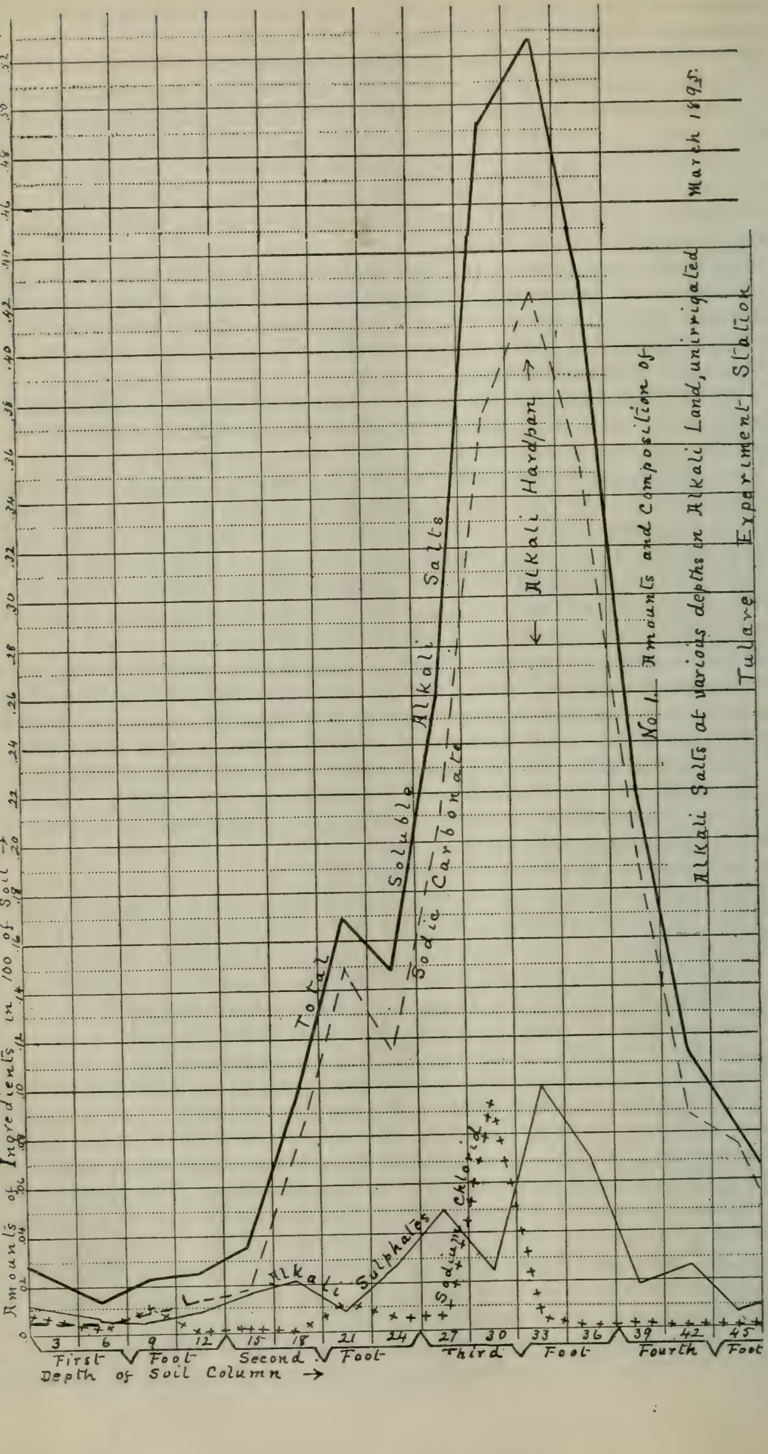
The section represented above was first taken in March in columns of three inches for the first foot, and then only averages of the second and third foot, respectively. The result was unsatisfactory; and in May the lower second, third, and fourth foot was again sampled in three-inch columns at a very short distance from the first locality. The changes shown in the 9–12-inch column are due doubtless more to difference in locality than to difference in time of sampling.

A glance at the columns shows a rapidly increasing amount of *total alkali salts* and of carbonate of soda after the first foot, except that at the bottom of the second foot there is a short and sharp decrease from some local cause. The maximum of total salts found at any point was a little more than half of one per cent of the soil, and occurred in the center of the hardpan at 30 to 33 inches below the surface. Here, too, was found the greatest *amount* of carbonate of soda and of sulphate, the former comprising 80 per cent of the total salts. Below 42 inches the amount of each ingredient is very small.

The *alkali sulphates* are irregularly distributed through the several soil-layers, though naturally largest in actual (absolute) amount in the hardpan, when all the salts are accumulated. In its relation to the total salts (or percentage-composition) the sulphate is highest in the upper 15 inches, with a maximum of 66.7 per cent at 9 to 12 inches.

The *carbonate of soda* is also in very large total *amount* in the hardpan, where it reaches nearly one half of one part in 100 of soil, or half of one per cent of the weight of the soil, and forms from 75 to 91 per cent of the soluble alkali salts. We find, too, that 73 per cent of the whole carbonate of soda found in the entire four feet of soil is held by the hardpan. In the upper foot its percentage falls below that of the sulphates, but below 15 inches it is the predominant ingredient, and its maximum proportion in the salts (93.8, or nearly 94 per cent) is reached between 42 and 45 inches, in striking contrast to the minimum proportion (22.7 per cent) found close to the surface, where the total amount of salts in the soil is nearly the same. The great practical significance of these facts will be more specially discussed below.

The *chlorid of sodium* is also distributed very irregularly through the soil-column, but reaches its absolute maximum in the hardpan.



No. 1. Amounts and Composition of Alkali Salts at various depths in Alkali Land, unirrigated. Tulare Experiment Station. March 1895.

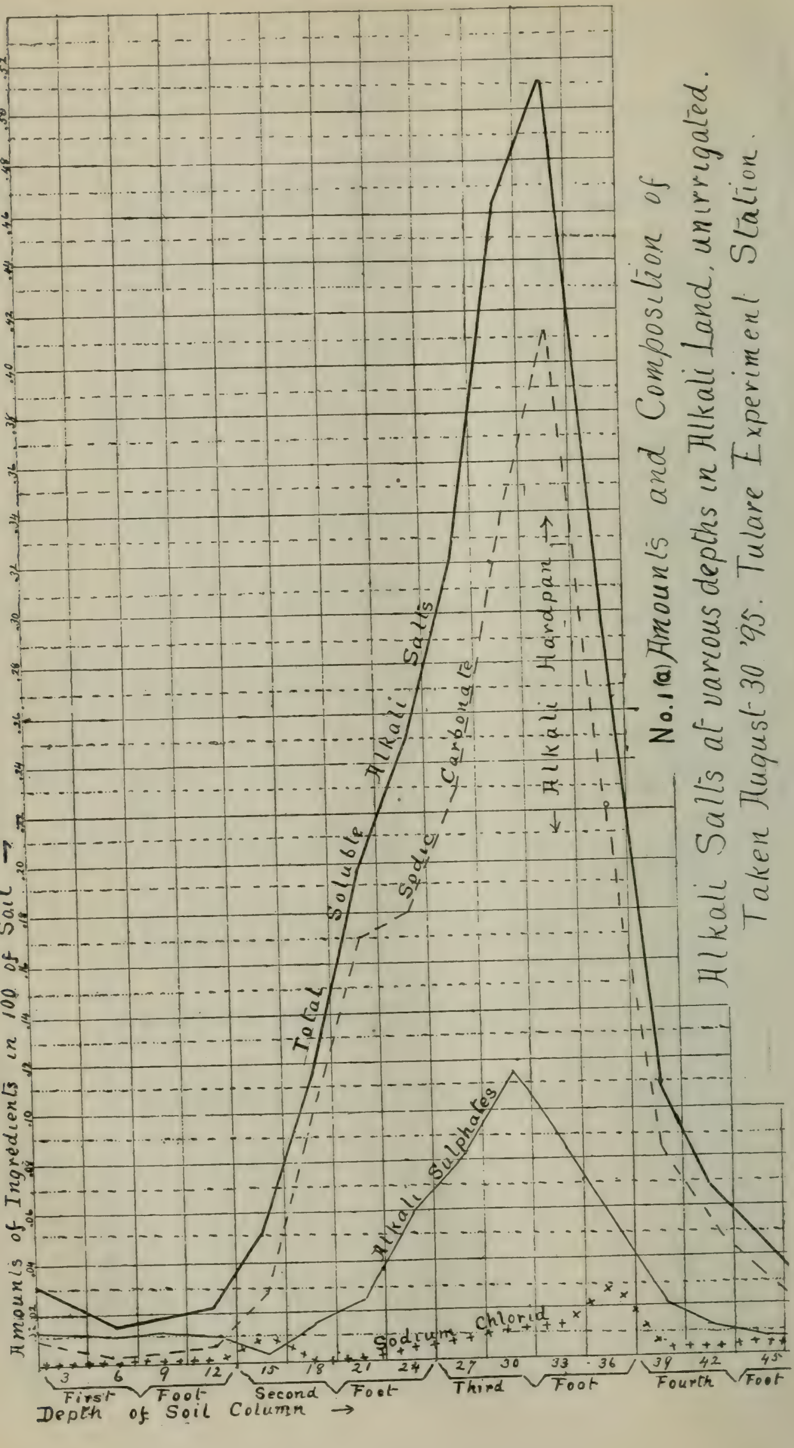
TABLE 1.—LEACHINGS OF UNIRRIGATED ALKALI SOIL. (Taken near Tulare—the upper part in March, when vegetation was green and fresh; the lower part in May, when vegetation was dry and partly gone.)

Depths at which Samples were Taken.		Parts in 100 of Soil.					In 100 Parts of Soluble Salts.				Amounts per Acre.				
		Total Soluble Alkali Salts.	Alkali Sulphates	Sodium Carbonate (Black Alkali.)	Sodium Chlorid (Common Salt.)	Sodium Nitrate	Alkali Sulphates	Sodium Carbonate	Sodium Chlorid	Sodium Nitrate	Total	Alkali Sulphates	Sodium Carbonate	Sodium Chlorid	Sodium Nitrate
											lbs.	lbs.	lbs.	lbs.	lbs.
0 to 3 inches		.022	.010	.005	.006	.001	45.5	22.7	27.2	4.6	220	100	50	60	10
3 to 6 inches		.013	.006	.004	.002	.001	46.1	30.7	15.4	7.8	130	60	40	20	10
6 to 9 inches		.022	.005	.008	.009	-----	22.7	31.8	45.5	-----	220	50	80	90	-----
9 to 12 inches		.024	.016	.006	.002	-----	66.7	25.0	8.3	-----	240	160	60	20	-----
9 to 12 inches*		.024	.009	.014	-----	.001	37.5	58.3	-----	4.2	240	90	150	-----	-----
Average for first foot		**.020**	**.009**	**.006**	**.005**	-----	**45.3**	**27.5**	**24.1**	**3.1**	**810**	**370**	**230**	**190**	**20**
12 to 15 inches		.035	.016	.017	.002	-----	45.7	48.6	5.7	-----	350	160	170	20	-----
15 to 18 inches		.095	.021	.074	-----	-----	22.1	77.9	-----	-----	950	210	740	-----	-----
18 to 21 inches		.169	.009	.148	.012	-----	5.3	87.5	7.2	-----	1,690	90	1,480	120	-----
21 to 24 inches		.147	.027	.115	.005	-----	18.3	78.2	3.5	-----	1,470	270	1,150	50	-----
Av. for second foot		**.112**	**.018**	**.089**	**.005**	-----	**22.9**	**73.0**	**4.1**	-----	**4,460**	**730**	**4,140**	**190**	-----
24 to 27 inches	Alkali Hardpan.	.262	.050	.206	.006	-----	19.1	78.6	2.3	-----	2,620	500	2,060	60	-----
27 to 30 inches		.491	.025	.373	.093	-----	5.2	75.9	18.9	-----	4,910	250	3,730	930	-----
30 to 33 inches		.529	.100	.424	.005	-----	18.9	80.1	1.0	-----	5,290	1,000	4,240	50	-----
33 to 36 inches		.426	.070	.356	Tr.	-----	16.9	83.1	-----	-----	4,260	700	3,560	-----	-----
Av. for third foot		**.427**	**.061**	**.340**	**.026**	-----	**15.0**	**79.5**	**5.5**	-----	**17,080**	**2,450**	**13,590**	**1,040**	-----
36 to 39 inches		.224	.018	.204	.002	-----	8.0	91.0	1.0	-----	2,240	180	2,040	20	-----
39 to 42 inches		.114	.026	.088	-----	-----	22.9	77.1	-----	-----	1,140	260	880	-----	-----
42 to 45 inches		.081	.005	.076	-----	-----	6.2	93.8	-----	-----	810	50	760	-----	-----
45 to 48 inches		.049	.013	.036	-----	-----	26.5	73.5	-----	-----	490	130	360	-----	-----
Av. for fourth foot		**.117**	**.016**	**.101**	-----	-----	**15.9**	**83.9**	**.2**	-----	**4,680**	**620**	**4,040**	**20**	-----
Av. for four feet		**.169**	**.026**	**.134**	**.009**	**Trace.**	**15.4**	**78.7**	**5.9**	-----	**27,030**	**4,170**	**22,000**	**1,420**	**20**

*This and the lower samples were taken in May.

Twelve-inch Samples Taken in March.

First foot	.021	.009	.006	.005	.001	45.2	27.5	24.2	3.1	840	360	240	200	40
Second foot	.108	.019	.084	.004	.001	17.6	77.8	3.7	0.9	4,320	760	3,360	160	40
Third foot	.240	.038	.193	.009	-----	15.8	80.4	3.8	-----	9,600	1,420	7,720	360	-----
Fourth foot	.117	-----	-----	-----	-----	-----	-----	-----	-----	4,680	620	4,040	20	-----



No. 1 (a) Amounts and Composition of Alkali Salts at various depths in Alkali Land, unirrigated. Taken August 30 '95. Tulare Experiment Station.

TABLE 2.—LEACHINGS OF UNIRRIGATED ALKALI SOIL. (Taken near Tulare, about ten feet from the May sample, September, 1895.)

Depths at which Samples were Taken.	Parts in 100 of Soil.					In 100 Parts of Soluble Salts.				Amounts per Acre.				
	Total Soluble Alkali Salts.	Alkali Sulphates	Sodium Carbonate	Sodium Chlorid	Sodium Nitrate	Alkali Sulphates	Sodium Carbonate	Sodium Chlorid	Sodium Nitrate	Total	Alkali Sulphates	Sodium Carbonate	Sodium Chlorid	Sodium Nitrate
										lbs.	lbs.	lbs.	lbs.	lbs.
0 to 3 inches	.026	.013	.008	....	.005	50.0	30.8	....	19.2	260	130	80	....	50
3 to 6 inches	.016	.012	.004	....	....	75.0	25.0	....	....	160	120	40	....	....
6 to 9 inches	.020	.014	.006	....	....	70.0	30.0	....	....	200	140	60	....	....
9 to 12 inches	.024	.013	.009	.002	....	54.1	37.5	8.4	....	240	130	90	20	....
Average for first foot	**.022**	**.013**	**.006**	....	**.001**	**59.1**	**27.4**	**4.9**	**9.1**	**860**	**520**	**270**	**20**	**50**
12 to 15 inches	.054	.004	.038	.012	....	5.6	72.2	22.2	....	540	40	380	120	....
15 to 18 inches	.117	.017	.100	....	....	14.5	85.5	....	....	1,170	170	1,100	....	....
18 to 21 inches	.197	.025	.170	.002	....	12.7	86.3	1.0	....	1,970	250	1,700	20	....
21 to 24 inches	.248	.060	.182	.006	....	24.2	73.4	2.4	....	2,480	600	1,820	60	....
Av. for second foot	**.154**	**.027**	**.122**	**.005**	....	**17.5**	**79.2**	**3.3**	....	**6,160**	**1,060**	**5,000**	**200**	....
24 to 27 inches Alkali Hardpan.	.320	.082	.229	.009	....	25.6	71.5	2.9	....	3,200	820	2,290	90	....
27 to 30 inches	.461	.115	.335	.011	....	24.9	72.6	2.5	....	4,610	115	3,350	110	....
30 to 33 inches	.512	.087	.411	.014	....	16.9	80.2	2.9	....	5,120	870	4,110	140	....
33 to 36 inches	.300	.054	.217	.029	....	18.0	72.3	9.7	....	3,000	540	2,170	290	....
Av. for third foot	**.398**	**.084**	**.298**	**.016**	....	**21.1**	**74.9**	**4.0**	....	**15,930**	**2,345**	**11,920**	**630**	....
36 to 39 inches	.110	.022	.085	.003	....	20.0	77.2	2.8	....	1,100	220	850	30	....
39 to 42 inches	.068	.012	.053	.003	....	17.6	77.9	4.5	....	680	120	530	30	....
42 to 45 inches	.045	.007	.032	.006	....	15.5	71.1	13.4	....	450	70	320	60	....
45 to 48 inches	.024	.005	.017	.002	....	20.8	70.8	8.4	....	240	50	170	20	....
Av. for fourth foot	**.062**	**.012**	**.047**	**.003**	....	**19.3**	**75.8**	**4.9**	....	**2,470**	**460**	**1,870**	**140**	....
Av. for four feet	**.159**	**.034**	**.119**	**.006**	....	**21.3**	**74.8**	**3.9**	....	**25,420**	**4,385**	**19,060**	**990**	**50**

Its actual amount in each three-inch layer is insignificant, though in the upper foot it forms a rather high percentage of the total alkali.

The *nitrate of soda*, being dependent in its formation upon free access of air, is naturally found only in the upper part of the soil, and in very small amount.

In order to ascertain the effect of a long summer's drought upon the position of the alkali salts in the unirrigated land, a series of samples was taken in September, 1895, within 15 feet of the former location, and similarly sampled and examined. The results are given in the accompanying Table 2 and diagram No. 1*a*. A mere glance at the latter, in comparison with the previous one, shows a very close correspondence not only in the general form of the curves representing the amounts of total salts, and its component ingredients, but even in the general details. Of course it is not to be expected that there will be exact agreement, even at nearer contact of the two series of samples. The result demonstrates beyond cavil that when the body of the alkali salts lie at a depth of three or more feet below the surface, there is no material rise of these salts so long as the land is not flooded with irrigation waters sufficient to penetrate to that depth and to dissolve them.

A comparison of the figures in Table 2, and those in Table 1, shows that while there is in these two groups of soils, taken several months apart, a general uniformity of increase in amount to the hardpan and then decrease to lower depths, there are differences in the total salts and the ingredients for the entire series, which, while not very large, are of interest. It is, of course, natural that the alkali should vary in strength or amount in various parts of the soil and within a few feet, and the fact that there is some 6 per cent more of total alkali salts in the samples taken in March than in September is not surprising.

When, however, we consider the relative proportions of each ingredient in the alkali salts, we find that apparently from March to September the sulphates have increased 6 per cent, the carbonate has fallen off 5 per cent, and the chlorid decreased 2 per cent. These differences may be due to a difference in locality, but it is an interesting fact that the chief change is from carbonate to sulphate. The hardpan contains 81 per cent of the total carbonate and 78 per cent of the total sulphate.

EFFECTS OF IRRIGATION.

The effects produced by irrigation upon land circumstanced as shown above were investigated on the same plan, on plots located within the Station grounds.

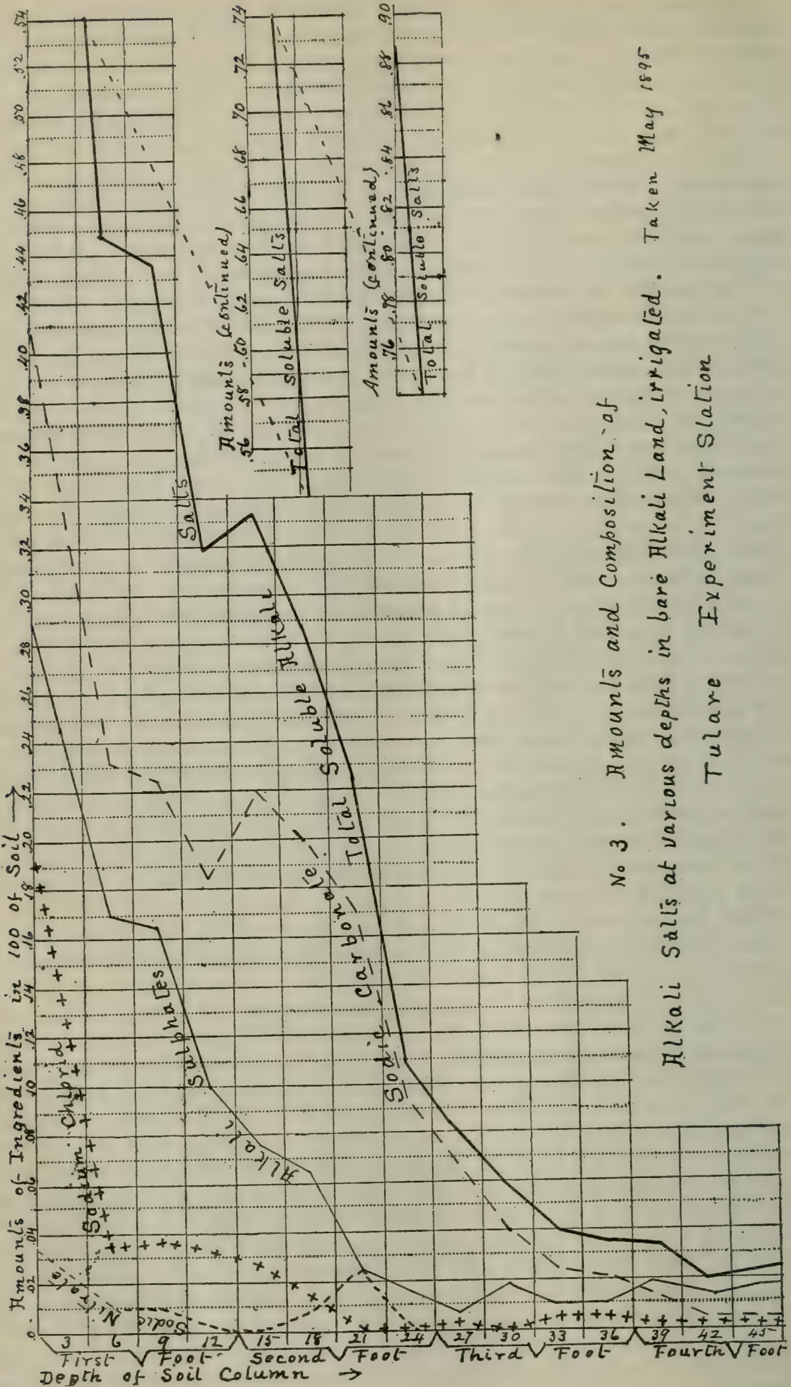
As regards the case of bottom-water rising from below, any one can see for himself that as the water of leaky ditches, filling up the land from below upward, comes in contact with the alkali-sodden subsoil or hardpan layer, it will dissolve the salts and carry them up toward the surface. Evaporation from the moistened surface will then go on all the year to a greater or less extent, and the alkali will keep steadily moving upward; until, in the course of a few years, the maximum will be found, not three feet below, but right *at* the surface. This is one phase of the "rise of the alkali," very easily understood in the light of Plate 1; and its outcome is graphically shown in Plate 3, on page 48, which scarcely requires comment.

This diagram (No. 3) and the table (No. 3) show the condition of land originally similar to that represented by Plate 1, but which has been irrigated for four or five years, and, quite lately, has also been influenced by a neighboring leaky ditch, outside of the Station inclosure. Here we see that the alkali has moved bodily upward, and has accumulated near and at the surface to such a degree that any useful growth of ordinary crops has become impossible. Seeds sown (except those of saltbushes) are quickly corroded or "rotted" by such alkali as this, and fail to sprout; anything set out, ready-grown, may live while the rains last, but will be promptly killed by the corrosion of the root-crown, or lower end of the stem, from the effect of the strong solution formed around it whenever a light rain or heavy dew falls, even if the root should be able to resist the action of the alkali within the soil itself.

It is not quite so easy to understand why *surface* irrigation should produce the same general result as the rise of the bottom-water from below; and yet a little consideration readily explains it. Under irrigation the land receives many times more water than in its natural condition, but rarely enough to leach the alkali salts into the country drainage, even if the impervious hardpan layer did not stand in the way. Practically all this irrigation water therefore ultimately evaporates in the course of the year. As it penetrates the soil to a greater depth than the natural rainfall ever goes, it gradually dissolves the alkali salts in the subsoil, and in the progress of its evaporation throughout the season, carries them with it toward the surface, instead of leaving most of them accumulated at between two and three feet depth, as in the natural state. In the course of time, especially in orchards where the soil remains bare and therefore exposed to evaporation throughout the season, the accumulation near the surface becomes so great as to injure even the bark of full-grown trees and vines; while ordinary herbaceous vegetation becomes impossible. If the alkali should be of the "black" kind—*i. e.*, carbonate of soda—the soil will soon begin to settle, and puddles of inky water will remain for some time after rains or irrigation; sometimes forming permanent "alkali ponds," with a bottom of tough, impervious hardpan, of the same nature as that shown in Plate 1, on page 42.

That these worst effects can be suppressed by the conversion of "black" alkali into "white," by means of gypsum, has been already sufficiently explained in former publications. The "white" or neutral alkali is many times less injurious than the "black," which is so corrosive that it dissolves not only the humus of the soil, but also the bark of plants; always excepting the wonderful "saltbushes," and their kind. But there are limits, varying for different plants, beyond which even the "white" alkali becomes incompatible with cultivation; so that its accumulation near the surface must always be prevented as much as possible. Diagram No. 3, on the next page, shows the condition of bare irrigated land in May; at the end of the dry season, we find nearly the whole of the alkali concentrated within six inches of the surface, as is shown by diagrams Nos. 4*a* and 4*b*, on page 52. These diagrams show strikingly that if we could afford to remove that first six inches of soil, we would have no more trouble from alkali; but at the same time, we would have seriously damaged the land's permanent productiveness.

In the columns of parts per 100 of soil in the table there is quite a regular decrease from the surface to the depth of four feet, except at the top of the second foot and at the bottom of the fourth foot. The upper twelve inches



No 3. Amounts and Composition of Alkali Salts at various depths in bare Alkali Land, irrigated. Taken May 1895

Tulare Experiment Station

TABLE 3.—LEACHINGS OF IRRIGATED BARE ALKALI SOIL. (From a spot within ten feet of where barley grew four feet high, at Tulare Experiment Station. Samples taken May 3, 1895.)

Depths at which Each Average Sample was Taken.	Parts in 100 of Soil.					In 100 Parts of Soluble Salts.				Amounts per Acre.				
	Total Soluble Alkali Salts.	Alkali Sulphates	Sodium Carbonate (Black Alkali.)	Sodium Chlorid (Common Salt.)	Sodium Nitrate	Alkali Sulphates	Sodium Carbonate	Sodium Chlorid	Sodium Nitrate	Total.	Alkali Sulphates	Sodium Carbonate	Sodium Chlorid	Sodium Nitrate
										lbs.	lbs.	lbs.	lbs.	lbs.
0 to 3 inches	.773	.251	.351	.144	.027	32.4	45.4	18.6	3.6	7,730	2,510	3,510	1,440	270
3 to 6 inches	.449	.170	.233	.035	.011	37.8	51.8	7.8	2.6	4,490	1,700	2,330	350	110
6 to 9 inches	.436	.164	.225	.037	.010	37.6	51.6	8.4	2.4	4,360	1,640	2,250	370	100
9 to 12 inches	.318	.099	.184	.033	.002	31.1	57.8	10.3	.8	3,180	990	1,840	330	20
Average for first foot	**.494**	**.171**	**.248**	**.062**	**.013**	**34.6**	**50.2**	**12.5**	**2.9**	**19,800**	**6,840**	**9,930**	**2,490**	**500**
12 to 15 inches	.332	.076	.229	.027	--------	22.9	68.9	8.2	--------	3,320	760	2,290	270	--------
15 to 18 inches	.286	.065	.199	.014	.008	22.8	69.5	4.9	2.8	2,860	650	1,990	140	80
18 to 21 inches	.223	.026	.170	trace.	.027	11.6	76.2	--------	12.2	2,230	260	1,700	--------	270
21 to 24 inches	.109	.016	.093	trace.	--------	14.7	85.3	--------	--------	1,090	160	930	--------	--------
Average for second foot	**.238**	**.046**	**.173**	**.010**	**.009**	**19.7**	**72.6**	**4.2**	**3.5**	**9,500**	**1,830**	**6,910**	**410**	**350**
24 to 27 inches	.080	.007	.068	.005	--------	8.7	85.0	6.3	--------	800	70	680	50	--------
27 to 30 inches	.058	.018	.040	trace.	--------	31.1	68.9	--------	--------	580	180	400	--------	--------
30 to 33 inches	.040	.010	.025	.005	--------	25.0	62.5	12.5	--------	400	100	250	50	--------
33 to 36 inches	.036	.010	.021	.005	--------	37.2	58.3	14.5	--------	360	100	210	50	--------
Average for third foot	**.054**	**.011**	**.039**	**.004**	--------	**20.3**	**72.2**	**7.5**	--------	**2,140**	**450**	**1,540**	**150**	--------
36 to 39 inches	.034	.019	.013	.002	--------	55.8	38.2	6.0	--------	340	190	130	20	--------
39 to 42 inches	.019	.013	.004	.002	--------	68.4	21.0	11.0	--------	190	130	40	20	--------
42 to 45 inches	.023	.017	.004	.002	--------	73.8	17.3	8.9	--------	230	170	40	20	--------
45 to 48 inches	.027	.018	.002	.007	--------	62.9	11.2	25.9	--------	270	180	20	70	--------
Average for fourth foot	**.026**	**.017**	**.006**	**.003**	--------	**65.4**	**23.0**	**11.4**	--------	**1,030**	**670**	**230**	**130**	--------
Average for four feet	.203	.061	.117	.020	.005	30.0	57.6	9.8	2.6	32,470	9,790	18,610	3,180	850

hold over three fifths of all and each of the salts, viz., 61 per cent of the total, distributed as follows: Nearly 70 per cent of all the sulphates, 54 per cent of the carbonate of soda, and 78 per cent of the chlorid of sodium. The total of 32,470 pounds per acre exceeds materially the totals shown in the irrigated lands described above.

Percentage Composition of the Salts.—In the *relative proportions* of the ingredients within each group of salts we find great differences. Throughout the series the *carbonate of soda* largely predominates, except in the lowest twelve inches, where it gives way to the alkali sulphates, though the actual amount is small. Its highest proportion (85.3 per cent) is in the lower part of the second foot; in fact, in the second and third feet the proportion of the carbonate is throughout higher than in the first and fourth. With the *sulphates* the converse is true, and we find the highest in the fourth foot, the next highest in the first (though lower than the carbonates), while in the central two feet the lowest percentages are found. The proportion of *chlorid* is greatest in the lowest and uppermost three inches, and generally quite low throughout the series.

EFFECT OF THE APPLICATION OF GYPSUM.

In September, 1894, the first examinations of alkali soils, with reference to their composition at successive intervals in depth, was undertaken on the soil of a portion of the tract lying between the north entrance and the northeast corner of the Station tract. Here there had originally been but a small depressed spot showing indications of alkali; but as the land was irrigated this spot expanded rapidly until, in the autumn of 1893, alkali salts appeared on the entire surface of the western three fifths of the distance between the northeast corner and the north entrance, for a width ranging from about 50 to over 300 feet from the north fence. At the same time all the fruit trees within these limits died out.

In 1894 and 1895 this land received each year dressings of gypsum at the rate of 1½ tons per acre; with the result that while in 1893 scarcely a blade of the barley sown matured seed, in 1894 (a very dry season) about half the land bore barley hay at the rate of a ton per acre, growing two feet high, and maturing seed where allowed to stand. In 1895 the reclamation had progressed nearly 100 feet farther east in the direction of the original spot. The barley sown refused to germinate only within the limits of that spot, but on the rest of the tract was two feet high in March, and four feet in May; the land yielding hay at the rate of 2½ tons per acre. The line between the reclaimed and unreclaimed land was very sharp, so that the luxuriant crop and the bare surface were at times within five feet of each other, with a narrow band of etiolated grain between. The samples described below were taken within 10 feet of each other in order to insure fair comparability of the results.

Table No. 4 (page 53) and diagrams of plot 4 show at a glance that in each of these two cases the bulk of the salts was located within the first three inches of the soil; the removal of which would therefore have relieved the land to a very material extent.

Bare Soil.—The *alkali sulphates* are in excess of the other ingredients throughout the first foot, in percentages varying from 60 in the upper three inches to 37.6 in the next. In the second foot they give place to the carbonate. Of the two alkalies, the potash is present in very small amounts.

The *carbonate of soda* is greatest in its amounts and percentages in the second foot, where it forms 76 per cent of the total, and probably still more in the next or third foot. At the surface its .074 per cent of the soil was sufficient to kill the barley as it sprouted.

The *chlorid* is greatest in amount at the surface three inches, where it comprises 31.3 of the total salt; but lower down in the soil the amounts and percentages of the whole are far less; and as an average of the second foot we find only .009, or 3.5 per cent.

The *nitrate* is naturally greatest in amount at the surface, though its proportion (percentage of the salts) was greatest just below.

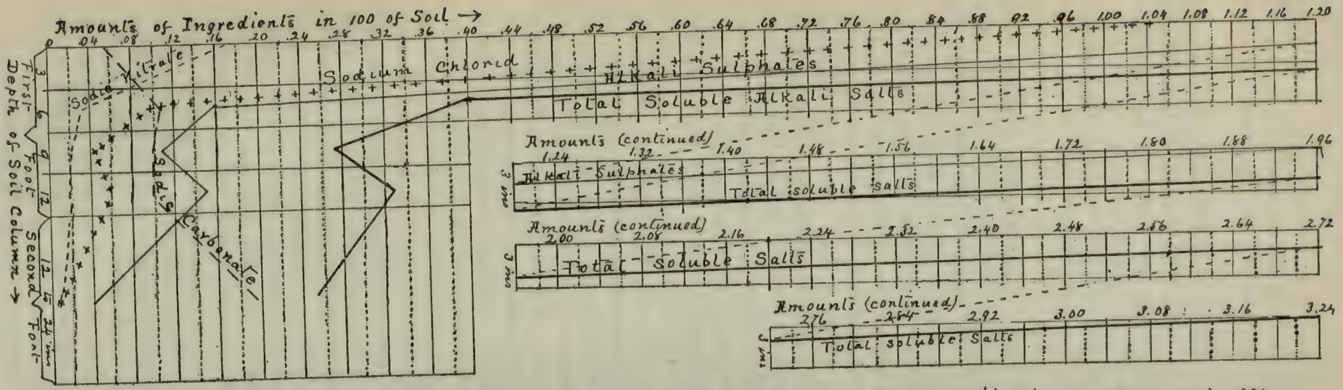
Soil on which Barley Grew.—In this we see that while the gypsum has not increased the sodic sulphate in actual *amount* above that of the bare soil, the *proportion* present in the upper six inches is greater, being 50 per cent in the first and 62 per cent in the latter. The amount and percentage of the carbonate are, on the contrary, very greatly reduced; thus clearly showing the action of the gpysum in its transformation of the corrosive carbonate to the neutral and comparatively harmless sulphate.

In the lower depths the action of the gypsum has been less marked, and we find more of the carbonate than at the surface, though its percentage has been greatly reduced and that of the sulphates increased.

The gypsum seems also to have acted on the potassic zeolites of the soil and released a portion of the potash from its combination and rendered it soluble in water, for there is quite an increase of the potassic sulphate, especially in the upper six inches.

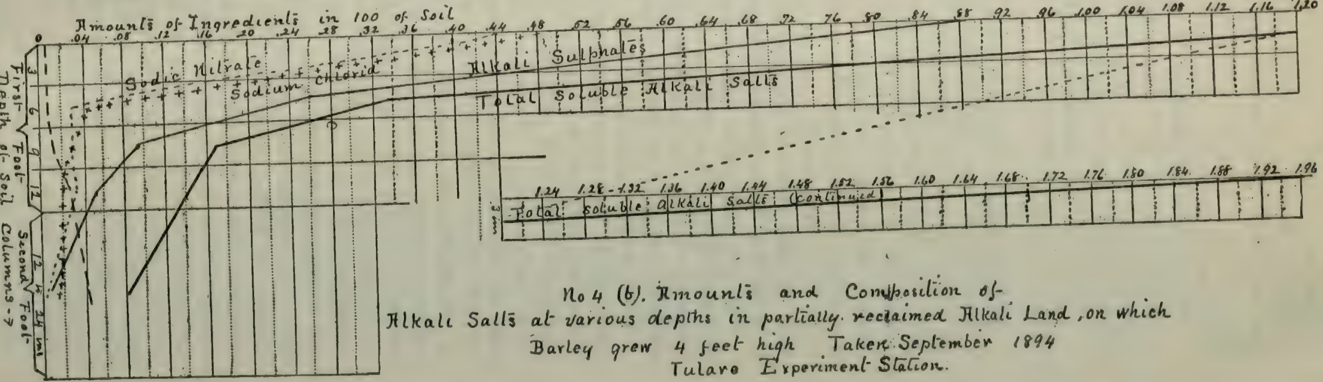
The nitrates also have been largely increased, as might be expected, from the known favorable influence of gypsum upon nitrification.

As the total amount of salts in No. 4*a* is more than double that in No. 4*b* (1.20 to 2.72 per cent), the difference in the behavior of the crop is not surprising. We may formulate upon it a conclusion to the effect that in a sandy loam, in which the upper three inches contain, at the end of the dry season, not over 1.4 per cent of alkali, consisting chiefly of Glauber's salt (sulphate of soda), barley can be made to yield a fair crop; it being understood that with more moisture (the land having purposely been left unirrigated) undoubtedly a larger hay crop would have been obtained. It is interesting to note in this connection, that in a similar soil near at hand, and entirely free from alkali, the grain crop was a total failure the same season. No. 4*a* having been treated with the same amount of gypsum as No. 4*b*, but containing double the amount of salts, of course the effect was inadequate, and much more carbonate remained unneutralized; although near the surface the difference was not very great, it sufficed to kill the seed at the time when, in consequence of the wetting of the land by rains, the more heavily carbonated salts had risen to the surface. That this was really so, and that to a degree not easily understood at first sight, is apparent from a glance at diagram No. 3, taken in May at a point only a few yards away from where No. 4*b* was sampled. Here we see the sodic carbonate largely in excess of the sulphate; indicating either that an additional supply of the latter had come up from below, or that a large proportion of the sulphate had been changed back into carbonate. That the latter is the true explanation, will be apparent from the consideration of diagrams Nos. 2*a* and 2*b*, on page 54.



No 4 (a) Amounts and Composition of Alkali Salts at various depths in Alkali Soil on which Barley would not grow. Taken Sept. 1894

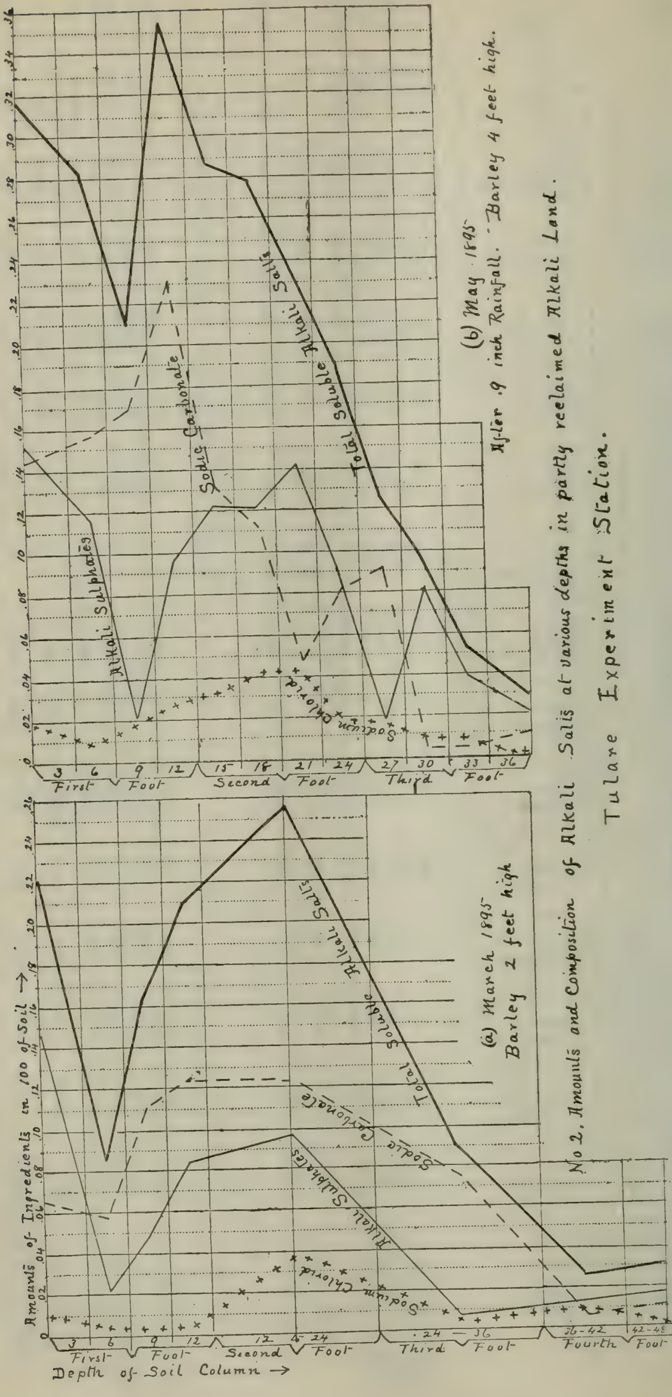
Tulare Experiment Station.



No 4 (b). Amounts and Composition of Alkali Salts at various depths in partially reclaimed Alkali Land, on which Barley grew 4 feet high Taken September 1894
Tulare Experiment Station.

TABLE 4.—(*a*) Leachings of Bare Alkali Soil, Treated with Gypsum, on which Barley Would not Grow. (Samples were taken Sept., 1894.)

Depths at which Each Average Sample was Taken.	Parts in 100 of Soil.						In 100 Parts of Soluble Salts.					Amounts per Acre.				
	Total Soluble Alkali Salts.	Potassium Sulphate....	Sodium Sulphate....	Sodium Carbonate ..	Sodium Chlorid.....	Sodium Nitrate	Potassium Sulphate....	Sodium Sulphate....	Sodium Carbonate ..	Sodium Chlorid.....	Sodium Nitrate	Total.	Alkali Sulphates...	Sodium Carbonate ..	Sodium Chlorid.....	Sodium Nitrate......
												lbs.	lbs.	lbs.	lbs.	lbs.
0 to 3 inches....	2.358	.005	1.416	.074	.739	.124	.2	60.1	3.1	31.3	5.3	23,580	14,210	740	7,390	1,240
3 to 6 inches....	.398	.009	.150	.106	.099	.034	2.8	37.6	26.2	24.9	8.5	3,980	1,590	1,060	990	340
6 to 9 inches....	.274	.005	.106	.098	.044	.021	2.1	38.6	35.7	16.0	7.6	2,740	1,100	980	440	210
9 to 12 inches...	.328	.004	.145	.098	.060	.021	1.3	44.2	29.8	18.3	6.4	3,280	1,490	980	600	210
Av., 1st foot..	**.840**	**.006**	**.454**	**.094**	**.236**	**.050**	**0.8**	**54.0**	**11.2**	**28.1**	**5.9**	**33,580**	**18,390**	**3,760**	**9,420**	**2,000**
Av., 2d foot...	**.252**	**.003**	**.038**	**.192**	**.009**	**.010**	**1.2**	**15.1**	**76.2**	**3.6**	**3.9**	**10,080**	**1,640**	**7,680**	**360**	**400**
Av. for 2 feet.	**.546**	**.005**	**.246**	**.143**	**.122**	**.030**	**1.1**	**45.0**	**26.1**	**22.3**	**5.5**	**43,660**	**20,030**	**11,440**	**9,780**	**2,400**
(*b*) Alkali Soil, Treated with Gypsum, on which One Ton per Acre of Barley Hay was Obtained. (Sample taken September, 1894.)																
0 to 3 inches	1.381	.094	.600	.008	.350	.329	6.8	43.4	.7	25.3	23.8	13,810	6,940	80	3,500	3,290
3 to 6 inches	.354	.015	.247	.008	.046	.038	4.2	69.7	2.5	12.9	10.7	3,540	2,520	80	460	380
6 to 9 inches	.174	.004	.093	.011	.035	.031	3.0	52.8	6.3	20.1	17.8	1,740	970	110	350	310
9 to 12 inches ...	.143	.009	.050	.029	.023	.032	6.6	34.9	20.2	16.0	22.3	1,430	590	290	230	320
Av., 1st foot.	**.513**	**.030**	**.248**	**.014**	**.113**	**.108**	**5.8**	**48.3**	**2.8**	**22.0**	**21.0**	**20,520**	**11,020**	**560**	**4,540**	**4,300**
Av., 2d foot...	**.083**	**.004**	**.021**	**.041**	**.014**	**.003**	**3.7**	**25.3**	**49.4**	**16.8**	**4.8**	**3,320**	**1,000**	**1,640**	**560**	**120**
Av. for 2 feet.	**.298**	**.017**	**.134**	**.028**	**.064**	**.055**	**6.0**	**44.9**	**9.3**	**21.4**	**18.4**	**23,840**	**12,020**	**2,200**	**5,100**	**4,420**



No 2. Amounts and Composition of Alkali Salts at various depths in partly reclaimed Alkali Land.

Tulare Experiment Station.

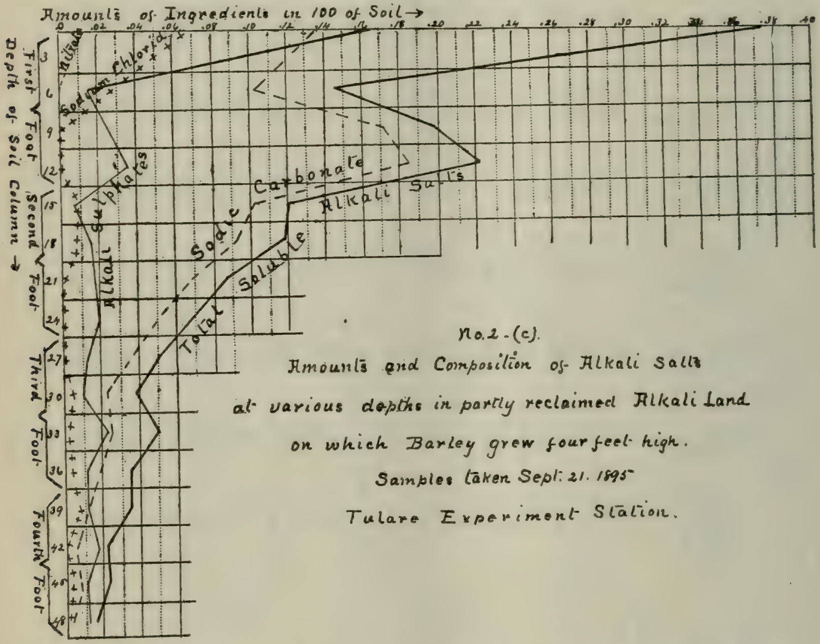
TABLE 5.—Leachings of Partly Reclaimed Alkali Soil. (a) *Samples Taken March 31, 1895, when Barley was Two Feet High.*

Depths at which Samples were Taken.	Parts in 100 of Soil.				In 100 Parts of Soluble Salts.			Amounts per Acre.			
	Total Soluble Alkali Salts.	Alkali Sulphates	Sodium Carbonate (Black Alkali.)	Sodium Chlorid (Common Salt.)	Alakali Sulphates	Sodium Carbonate	Sodium Chlorid	Total	Alkali Sulphates	Sodium Carbonate	Sodium Chlorid
								lbs.	lbs.	lbs.	lbs.
0 to 3 inches	.178	.105	.064	.009	58.9	35.9	5.2	1,780	1,050	640	90
3 to 6 inches	.085	.022	.059	.004	25.8	69.4	4.8	850	220	590	40
6 to 9 inches	.163	.049	.110	.004	28.4	67.4	4.2	1,630	490	1,100	40
9 to 12 inches	.210	.083	.123	.004	39.5	58.6	1.9	2,100	830	1,230	40
Average for first foot	**.159**	**.065**	**.089**	**.005**	**40.9**	**56.0**	**3.1**	**6,360**	**2,590**	**3,560**	**210**
Average for second foot	**.256**	**.096**	**.123**	**.037**	**37.5**	**48.0**	**14.5**	**10,240**	**3,840**	**4,920**	**1,480**
Average for third foot	**.088**	**.007**	**.076**	**.005**	**7.9**	**86.3**	**5.8**	**3,520**	**280**	**3,040**	**20**
36 to 42 inches	.025	.012	.006	.007	48.0	25.0	27.0	500	240	120	140
42 to 48 inches	.029	.018	.009	.002	58.5	39.1	10.4	580	360	180	40
Average for fourth foot	**.027**	**.015**	**.008**	**.004**	**55.5**	**29.6**	**14.9**	**1,080**	**600**	**300**	**180**
Average for four feet	**.133**	**.046**	**.074**	**.013**	**34.5**	**55.6**	**9.9**	**21,200**	**7,310**	**11,820**	**1,890**
(*b*) *Samples taken in May, 1895, when Barley was four feet high.* (A rainfall of 0.9 of an inch had recently occurred.)											
0 to 3 inches	.308	.141	.148	.016	46.2	48.5	5.3	3,080	1,410	1,480	160
3 to 6 inches	.282	.117	.156	.009	41.4	55.3	3.3	2,820	1,170	1,560	90
6 to 9 inches	.210	.021	.170	.019	10.0	80.9	9.1	2,100	210	1,710	190
9 to 12 inches	.353	.096	.229	.028	27.2	64.8	8.0	3,530	960	2,290	280
Average for first foot	**.288**	**.094**	**.176**	**.018**	**32.6**	**61.1**	**6.3**	**11,530**	**3,750**	**7,040**	**720**
12 to 15 inches	.286	.122	.131	.033	42.7	45.8	11.5	2,860	1,220	1,310	330
15 to 18 inches	.278	.121	.115	.042	43.5	41.4	15.1	2,780	1,210	1,150	420
18 to 21 inches	.233	.142	.049	.042	60.9	21.0	18.1	2,330	1,420	490	420
21 to 24 inches	.188	.088	.081	.019	46.8	43.0	10.2	1,880	880	810	190
Average for second foot	**.246**	**.118**	**.094**	**.034**	**47.9**	**38.2**	**13.9**	**9,850**	**4,730**	**3,760**	**1,360**
24 to 27 inches	.126	.017	.090	.019	13.5	71.4	15.1	1,260	170	900	190
27 to 30 inches	.095	.082	.004	.009	86.3	4.2	9.5	950	820	40	90
30 to 33 inches	.052	.038	.004	.009	73.0	7.6	19.4	520	380	40	90
33 to 36 inches	.036	.027	.009		75.0	25.0		360	270	90	
Average for third foot	**.077**	**.041**	**.027**	**.009**	**53.2**	**35.0**	**11.8**	**3,090**	**1,640**	**1,070**	**370**
Average for three feet	**.152**	**.063**	**.074**	**.015**	**41.4**	**48.7**	**9.9**	**24,470**	**10,120**	**11,870**	**2,450**

EFFECT OF CROPPING.

To ascertain the effect of growing a crop upon alkali land after it has been treated with an application of gypsum to neutralize the corrosive action of the carbonate of soda at the surface, a series of samples was taken on March 31, 1895, from the partly reclaimed tract in the northeast corner of the Station. In the upper foot, averages were taken of every three inches; then averages of the second and third twelve inches, respectively; while of the fourth foot, averages of six inches were taken.

The results proved rather unsatisfactory in lacking detail, which would, if the sections below twelve inches were subdivided, show more exactly the extreme points of curving. Thus, in the second foot, the maximum outward point would have been found to be much greater in the upper part than is shown in an average of the whole foot, and instead of .26 of the latter we would have found about .36 in the upper three or second three inches of that foot, with a corresponding decrease in the lower part. In May, therefore, another series of samples was taken within a few feet of the first, each representing an average of three inches to the depth of four feet. This gave more satisfactory results. A rainfall of nearly an inch had, however, occurred a short time previous, which had its effect in driving the alkali downward. The barley had, in the interval, grown to four feet in height.



No. 2-(c).

Amounts and Composition of Alkali Salts at various depths in partly reclaimed Alkali Land on which Barley grew four feet high.

Samples taken Sept. 21. 1895

Tulare Experiment Station.

In order to ascertain the effect of the heat and drought of the summer upon the partly reclaimed alkali land, or rather upon the position of the several salts at various depths, another series of three-inch samples was taken in September, or four months after the previous ones, and very near the same spots. No rain had fallen during that time. The crop

TABLE 5—Continued. (c) *Samples taken in September, 1895, after five months of drought.*

Depths at which Samples were Taken.	Parts in 100 of Soil.					Percentage Composition.				Amounts per Acre.				
	Total Soluble Alkali Salts.	Alkali Sulphates	Sodium Carbonate	Sodium Chlorid	Sodium Nitrate	Alkali Sulphates	Sodium Carbonate	Sodium Chlorid	Sodium Nitrate	Total.	Alkali Sulphates	Sodium Carbonate	Sodium Chlorid	Sodium Nitrate
										lbs.	lbs.	lbs.	lbs.	lbs.
0 to 3 inches	.303	.116	.123	.055	.009	38.2	40.6	18.1	3.1	3,030	1,160	1,230	550	90
3 to 6 inches	.145	.015	.102	.028	-------	10.4	70.3	19.3	-------	1,450	150	1,020	280	-------
6 to 9 inches	.198	.026	.170	.002	-------	13.1	85.8	1.1	-------	1,980	260	1,700	20	-------
9 to 12 inches	.220	.036	.184	-------	-------	16.4	83.6	-------	-------	2,200	360	1,840	-------	-------
Average for first foot	**.216**	**.048**	**.145**	**.021**	**.002**	**22.2**	**67.1**	**10.1**	**0.6**	**8,660**	**1,930**	**5,790**	**850**	**90**
12 to 15 inches	.120	.008	.102	.010	-------	6.6	85.0	8.4	-------	1,200	80	1,020	100	-------
15 to 18 inches	.117	.015	.093	.009	-------	12.8	79.5	7.7	-------	1,170	150	930	90	-------
18 to 21 inches	.087	.017	.068	.002	-------	19.4	78.1	2.5	-------	870	170	680	20	-------
21 to 24 inches	.071	.020	.051	-------	-------	28.1	17.9	-------	-------	710	200	510	-------	-------
Average for second foot	**.099**	**.015**	**.079**	**.005**	-------	**15.1**	**79.7**	**5.2**	-------	**3,950**	**600**	**3,140**	**210**	-------
24 to 27 inches	.051	.013	.038	-------	-------	25.5	74.5	-------	-------	510	130	380	-------	-------
27 to 30 inches	.038	.010	.023	.005	-------	26.3	60.5	13.2	-------	380	100	230	50	-------
30 to 33 inches	.049	.022	.025	.002	-------	44.9	51.0	4.1	-------	490	220	250	20	-------
33 to 36 inches	.035	.012	.019	.004	-------	34.3	54.3	11.4	-------	350	120	190	40	-------
Average for third foot	**.043**	**.014**	**.026**	**.003**	-------	**32.5**	**60.4**	**7.1**	-------	**1,730**	**570**	**1,050**	**110**	-------
36 to 39 inches	.035	.014	.013	.008	-------	40.0	37.1	22.9	-------	350	140	130	80	-------
39 to 42 inches	.023	.017	.006	-------	-------	73.9	26.1	-------	-------	230	170	60	-------	-------
42 to 45 inches	.023	.011	.008	.004	-------	47.4	34.8	17.8	-------	230	110	80	40	-------
45 to 48 inches	.016	.012	.002	.002	-------	75.0	12.5	12.5	-------	160	120	20	20	-------
Average for fourth foot	**.024**	**.013**	**.007**	**.004**	-------	**54.1**	**29.1**	**16.8**	-------	**970**	**540**	**290**	**140**	-------
Average for four feet	**.095**	**.023**	**.064**	**.008**	**trace**	**24.2**	**67.4**	**8.4**	-------	**15,310**	**3,640**	**10,270**	**1,310**	**90**

of barley had ripened, and hence there was no more evaporation through roots and leaves. The accompanying Table No. 5 and diagrams 2, *a*, *b*, and *c*, give the results of examination of the samples.

The relationship of the above figures, showing amounts in 100 parts of the soil, is brought out in the diagrams better than by quoting the figures themselves, though these show great variations.

Plate 2 shows the effect of a growing crop on the same land as that in Plate 3, within the Station grounds, the samples on the two plates having been taken within ten feet of each other. But a heavy dressing of gypsum had been applied where 2*a* and 2*b* were taken, with good irrigation; and barley was sown in January, 1895. The rather abundant rains which fell afterward, naturally leached the alkali salts away from the surface, so as to leave it quite weak within the first foot. Evidently, the barley germinated and made its first growth under these conditions. But as it failed to cover the ground fully, some surface evaporation took place, and the alkali began an upward movement, the effect of which, in the increase of salts at the surface, is seen in both figures (2*a* and 2*b*), but modified, in the later one, by the contrary effect of a light late rain, which again diminished somewhat the salts at the surface. These three profiles are clearly the transition phase between the natural condition of the land as shown in Plate 1, and that of a bare alkali spot as exemplified in Plate 3; and illustrates well the effect produced upon evaporation, and the consequent movement of the alkali salts, even by a cereal crop, with its shallow roots and thin foliage. It is obvious that a crop of alfalfa, once established upon this land, and bringing to bear upon it the action of its deep roots and dense shade, would, by the repression of surface evaporation, tend to restore the natural condition as shown in Plate 1.

That there has been an upward movement of the alkali in the second and third foot of the last diagram is clearly shown. There has also been a rise in the sharp inner curve of the ninth inch to the sixth inch, which causes the line connecting the average of the latter with that of the three-inch in the diagram, to be extended farther out at the surface than in previous samples. The several individual salts have been changed in their curves or outlines very materially, perhaps because of the dry and hot summer season, which would naturally produce exchanges of constituents in the alkali salts. The maximum percentage of carbonate of soda still remains, however, in the lower three inches of the first foot, and that at the surface is almost the same (14 per cent).

TOTAL AMOUNTS OF SALTS, IN POUNDS PER ACRE, IN THE SEVERAL SOILS.

While it is true that the injury from alkali is usually done mainly or wholly by that portion which rises within a few inches of the surface, yet since that amount depends largely (as has been shown) upon conditions of rainfall or irrigation, and evaporation, varying not only from year to year, but at different times within the same season, it is both interesting and practically important to know just what is the maximum amount of alkali salts that we may have to deal with in any given case. This is feasible whenever (as the preceding investigations indicate is usually the case) practically all the alkali salts are contained within the first three or four feet from the surface down. In the tables above, the summations are given for each substance in each foot of the profile, also a summation of the totals of the whole number of feet. But, for the sake of more ready comparison, these latter summations are tabulated separately below, affording a clearer insight into the limits of vegetable endurance, and of the chances of profitable reclamation, by calculating the statements to pounds per acre on the basis of 4,000,000 pounds per acre-foot:*

TABLE 1.—IRRIGATED LAND ON WHICH CULTURE PLANTS WOULD NOT GROW.
(Amounts per Acre.)

	No. 3. Samples Taken in May, 1895.					No. 4*a*. Samples Taken in Sept., 1894.				
	Total Soluble Salts.	Sulphates	Carbonates	Chlorids	Nitrates	Total Soluble Salts.	Sulphates	Carbonates	Chlorids	Nitrates
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
First foot	19,800	6,840	9,930	2,490	500	33,580	18,390	3,760	9,420	2,000
Second foot	9,500	1,830	6,910	410	350	10,080	1,640	7,680	360	400
Totals	29,300	8,670	16,840	2,900	850	43,660	20,030	11,440	9,780	2,400
Third foot	2,140	450	1,540	150	------					
Fourth foot	1,030	670	230	130	------					
Totals	32,470	9,790	18,610	3,180	850					

TABLE 2.—ALKALI SOILS ON WHICH CULTURE PLANTS WOULD GROW.
(Amounts per acre.)

	No. 2*a*. Barley 2 Feet High. Taken in March, 1895.					No. 2*b*. Barley 4 Feet High. Taken in May, 1895.				
	Total Soluble Salts.	Sulphates	Carbonates	Chlorids	Nitrates	Total Soluble Salts.	Sulphates	Carbonates	Chlorids	Nitrates
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
First foot	6,360	2,590	3,560	210	----	11,530	3,750	7,040	720	---
Second foot	10,240	3,840	4,920	1,480	----	9,850	4,730	3,760	1,360	----
Third foot	3,520	280	3,040	20	----	3,090	1,640	1,070	370	----
Fourth foot	1,080	600	300	180	----	†1,080	600	300	180	----
Totals	21,200	7,310	11,820	1,890	----	25,550	10,720	12,170	2,630	----

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*The alkali hardpan, in its natural condition, was found to weigh 4,500,000 pounds per acre-foot; the same pulverized, between 3,500,000 and 3,600,000 pounds. It thus seems fair to assume the average weight of natural soil per acre-foot at about 4,000,000 pounds.

† Taken from the March figures.

TABLE 2—Continued.

	No. 2*c*. After Crop Harvested. Taken in September, 1895.					No. 4*b*. Barley, One Ton Harvested. Taken in September, 1894.				
	Total Soluble Salts.	Sulphates	Carbonates	Chlorids	Nitrates	Total Soluble Salts.	Sulphates	Carbonates	Chlorids	Nitrates
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
First foot	8,660	1,930	5,790	850	90	20,520	11,020	560	4,540	4,300
Second foot	3,950	600	3,140	210	----	3,320	1,000	1,640	560	120
Third foot	1,730	570	1,050	110	----	--------	--------	------	------	------
Fourth foot	970	540	290	140	----	--------	--------	------	------	------
Totals	15,310	3,640	10,270	1,310	90	23,840	12,020	2,200	5,100	4,420

TABLE 3.—SHOWING AMOUNTS OF ALKALI SALTS PER ACRE—UNIRRIGATED ALKALI LAND COVERED WITH NATURAL VEGETATION.

	(*a*) Samples Taken in March.					(*b*) Samples Taken in September.				
	Total Soluble Salts.	Sulphates	Carbonates	Chlorids	Nitrates	Total Soluble Salts.	Sulphates	Carbonates	Chlorids	Nitrates
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
First foot	810	370	230	190	20	860	520	270	20	50
Second foot	4,460	730	4,140	190	------	6,160	1,060	5,000	200	------
Third foot	17,080	2,450	13,590	1,040	------	15,930	2,340	11,920	630	------
Fourth foot	4,680	620	4,040	20	------	2,470	460	1,870	140	------
Totals	27,030	4,170	22,000	1,440	20	25,420	4,380	19,060	990	50

Considering, first, the two samples taken from bare alkali land on which barley refused to germinate or grow (plate 3 and plate 4*a*), we find for the respective totals the figures 32,470 pounds (for four feet) and 43,660 pounds (for two feet) per acre. In the case of the lower amount, over half of the total (18,610 pounds) is carbonate of soda; in the sample taken in September, 1894, showing the higher amount (43,660 pounds), only one fourth is carbonate. But evidently this large amount, even if chiefly composed of neutral salts, exceeds the endurance of any culture plant thus far tried, except the Australian saltbushes.

Comparing with this the results obtained from land on which barley *would* grow, yielding in 1895 nearly at the rate of 2½ tons of hay per acre, we find in the sample taken in March, 21,200 pounds; in that of May, when the barley was four feet high, a total of 25,550 pounds. The latter, a very large amount surely, is thus evidently within the limits of endurance for barley, and that despite the fact over one half of the salts was "black," *i. e.* carbonate of soda. In this later sample, the *proportion* of carbonate being nearly the same, the upper foot contained nearly twice the amount of both total salts and carbonate, and yet the barley yielded well, showing a remarkable resistance for that grain. Curiously enough, a sample taken in September of the same year, within a few feet of the same bore-hole, showed only 15,310 pounds of total salts, and a greatly diminished amount in the first foot. It is difficult to account for this, save on the supposition that much of the alkali that had risen to the surface was blown away by the summer winds. But it will be noted that in September of the previous year (1894), the total salts, taken from a spot about forty feet away, and also yielding a good barley crop for that season, amounted to 23,840 pounds in the upper two feet alone, with over 20,000 pounds in the first foot.

Turning now to the unirrigated land which bore the natural growth of the region in March and September, we find that at the former time, the total of salts within the four-foot limit was 27,030 pounds, with only 230 pounds of carbonate in the first foot, but 13,590 pounds in the third one (hardpan layer), which, however, was not reached by the roots. In September the total was 25,420 pounds, but the total salts had not materially increased within the first foot, and the carbonate of soda had actually diminished by 100 pounds. A reference to the figures for the ground on which barley yielded well, proves that this soil would do the same, provided its carbonate of soda were neutralized by gypsum to the same extent.

It is evident, from the facts just given, that *for barley the limit of toleration* consistent with a full hay crop, under otherwise favorable conditions and with salts consisting of not over one-half of carbonate of soda, lies somewhere between 25,500 and 32,000 pounds per acre, in round numbers, within the first four feet of soil and subsoil; always provided, that the layer so limited contains substantially all the salts likely to come within reach of surface evaporation. Expressed in percentages of the soil and subsoil mass itself, this indicates, respectively, .159 and .203.

This mode of attacking the problem would thus seem to simplify enormously the testing of a given piece of land as to the feasibility and method of reclamation. It would simply be necessary to sample an entire soil column to the depth of four feet, and by one single analysis, instead of sixteen, to determine the amount and kind of salts present in it. Should the percentage of total salts in the soil not materially exceed the lower of the above figures (perhaps up to the limit of .175 per cent), nor the carbonate percentage one half of the above, we may consider that, for barley at least, the land can be reclaimed by simply treating with gypsum, and deep and thorough culture; while any land of which the salt-content, ascertained by the same method, falls materially below the above figure, may be confidently taken into cultivation, even when covered with alkali grass.

The limits of tolerance for other culture plants doubtless differ greatly, and have to be separately ascertained for each one.

The table on page 63 gives some additional data obtained in the course of somewhat desultory efforts, made prior to the investigation of the four-foot columns, to ascertain the limits of tolerance by the examination of the first foot of soil only. We thus see that on the land where a *good crop of barley* was made, the surface foot contained an average of .185 per cent of total salts, of which nearly seven ninths was carbonate of soda. In August of the same year, after the barley had been harvested in May, we find .305 per cent in the first foot, with no carbonate; near by, on a spot where barley was living but not doing so well, the total salts ranged from nearly .400 to over .500 per cent.

On a spot where the *barley died* there was found in August, in the surface foot, the enormous amount of 1.81 per cent of total salts, or over 72,000 pounds to the acre in the first foot, of which 20,000 pounds was carbonate of soda; and in the same year (1894), *pear trees* several years old were killed by an accumulation of over 1½ per cent of total salts in the surface foot, or nearly 63,000 pounds per acre; of which 32,000 pounds, in round numbers, was Glauber's salt, 18,400 pounds common salt, with 8,000 pounds, or four tons, of Chile saltpeter (worth, at present prices, $200); while the carbonate is reduced to about 2½ tons.

It will be instructive to ascertain, by boring on these spots the coming season, the grand total of salts in the four-foot column, which will probably reach nearly the hundred thousand mark. It is doubtful whether a soil so heavily impregnated can be made to serve any useful purpose without an actual leaching-out of a large portion of the salts by the aid of underdrainage.

AUSTRALIAN SALTBUSH ON ALKALI SOIL.

Some preliminary data regarding the resistance of the Australian saltbush are given in the table on page 63, also on the basis of the surface foot.

It will be noted that the saltbush came up easily from seed on land of which the surface foot contained a third of one per cent of salts, but languished, although they did not die, when that amount reached one half of one per cent; the surface foot then containing not less than 31,000 pounds of total salts per acre. Where the surface crust (including about half an inch of the surface soil) contained nearly 8 per cent of total salts, of which one half was Glauber's salt, the rest almost evenly divided between the carbonate and common salt, the young plants of saltbush scarcely kept alive; they died when the accumulation rose to over 25 per cent of the first half inch, six tenths being Glauber's salt and one and a half tenth carbonate of soda; a weakness which, under the circumstances, must be considered pardonable.

PERCENTAGE COMPOSITION OF THE ALKALI SALTS.

In studying the composition of the alkali salts, with reference to their proportions among themselves and not to the soil, we find some interesting facts which do not appear clearly in the columns or plates; the variation of one and the same substance at the several depths is far greater than is shown in the actual amounts.

In the samples taken in March (page 59), the sulphates formed more than half of the alkali salts at the surface and in the lower portions of the fourth foot. At other points its percentage varied from 25.8 and above, but was remarkably low (7.8 per cent) in the third foot. The carbonates, on the other hand, predominated in the first and third foot, except in the top three inches. The chlorid was highest in the second foot.

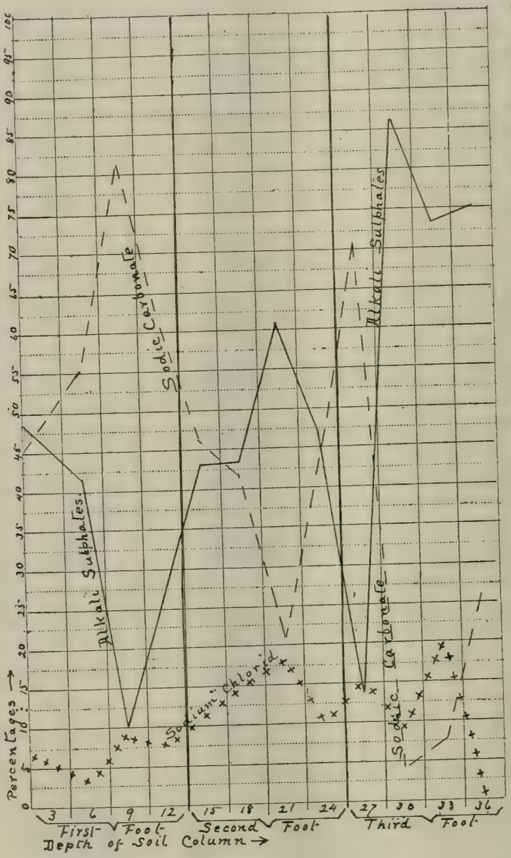
In the May sample, the sulphates predominated in the lower half of the three-foot column of soil (excepting at one point), while, on the

EFFECT OF ALKALI SALTS ON BARLEY, ETC.

Alkali Soils—12 Inches.	Date when Taken.	Parts in 100 of Soil.					In 100 of Soluble Salts.				Amounts per Acre.				
		Total Soluble Alkali Salts	Alkali Sulphates	Sodium Carbonate	Sodium Chlorid	Sodium Nitrate	Alkali Sulphates	Sodium Carbonate	Sodium Chlorid	Sodium Nitrate	Total Soluble Salts	Sulphates	Carbonates	Chlorids	Nitrates
											lbs.	lbs.	lbs.	lbs.	lbs.
Barley 2 feet high, no efflorescence	March, 1894	.185	.040	.136	.005	.003	21.7	73.9	2.7	1.7	7,400	1,600	5,440	200	120
Barley 4 feet high, no efflorescence	August, 1894	.305	.188	------	.064	.053	61.6	------	20.9	17.5	12,200	7,520	--------	2,560	2,120
Barley field, efflorescence just beginning	March, 1894	.501	.254	.170	.054	.023	50.7	33.9	10.7	4.7	20,040	10,160	6,800	2,160	920
Barley living, efflorescence just beginning	March, 1894	.379	.169	.170	.037	.003	44.5	44.8	9.8	0.9	15,160	6,760	6,800	1,480	120
Barley field, strong efflorescence	March, 1894	.512	.262	.179	.063	.008	51.1	34.9	12.3	1.7	20,480	10,480	7,160	2,520	320
Barley died	August, 1894	1.810	.762	.509	.485	.054	42.1	28.1	26.8	3.0	72,400	30,480	20,360	19,400	2,160
Pears died	August, 1894	1.570	.795	.115	.460	.200	50.6	7.3	29.3	12.8	62,800	31,800	4,600	18,400	8,000

EFFECT OF ALKALI SALTS UPON THE SALTBUSH.

Alkali Soils—12 Inches.										lbs.	lbs.	lbs.	lbs.	lbs.
Saltbush came easily up from seed	.325	.126	.127	.067	.005	38.8	39.0	20.6	1.6	13,000	5,040	5,080	2,680	200
Saltbush languishes while young	.773	.259	.233	.280	.001	33.5	30.1	36.2	0.2	30,920	10,360	9,320	11,200	40
Alkali Crusts.														
Saltbush scarcely lives	7.960	4.280	1.820	1.680	.180	53.8	22.9	21.1	2.2	-------	-------	-------	-------	-----
Saltbush died	25.702	15.447	3.774	6.078	.403	60.1	14.7	23.6	1.6	-------	-------	-------	-------	-----



Percentage Composition of Alkali Salts at various depths in partly reclaimed Alkali Land
May, 1895. Barley 4 feet high. Tulare Experiment Station.

contrary, the carbonate had its maximum percentage in the upper half of the column, with a large one also in the upper part of the third foot. Here again the chlorid was largest in the lower half.

In September we again find that, with the exception of the upper three inches, the sulphates predominate in the fourth foot only, giving way to the carbonates above. The chlorid was very irregular, greatest at 36 inches and in the upper six inches, while at some points mere traces were present.

Throughout the whole of the series the sulphates and carbonates, in their respective percentages or relations to the total alkali salts, are placed in inverse ratios—when the one is high the other is low, and *vice versa.* This is most marked in the samples taken in May, and is well shown in the accompanying diagram, which represents on an enlarged scale the variations seen in the diagram of the May sample (Plate 2*b*).

A glance at the plate shows that the sulphate and carbonate are about equal at the surface, but then begin to recede from each other, and in the sixth to the ninth inch reach, respectively, a minimum and maximum percentage, viz., 10 of sulphate, and about 81 of carbonate. They then again approach each other until their percentage curves cross at 15 inches, and they take opposite positions of 60.9 of sulphate and 21 of carbonate. The lines then again cross, and we have 13.5 of sulphate and 71.4 of carbonate. The final crossing of curves occurs at 27 inches, where the sulphate reaches its maximum of .86.3, and the carbonate its minimum of 4.2 per cent.

How Black Alkali May be Formed.—In view of the great difference in the injuriousness of the different salts usually composing "alkali," it is of considerable practical interest to understand the conditions under which such variations, as those shown in the preceding plate, can occur. For if in one and the same spot we may at one season find the alkali very "black," and at another almost neutral, or "white," the agencies by which these changes may be brought about should be known, and, if possible, controlled. While we probably do not as yet fully understand all the minor points of this question, the main facts have been elucidated by an investigation made at this Station as far back as 1887, and communicated at the meeting of the American Society for the Promotion of Agricultural Science in August, 1888.*

The essential point is, that when the sulphates or chlorids of the alkalies (potassium and sodium) come in contact with the carbonates of lime or magnesia in presence of water only, no change takes place. But so soon as carbonic acid, either free or in the form of supercarbonates, is also present, an exchange of ingredients occurs, the whole or a part of the alkalies becoming carbonates, while the lime or magnesia enter into combination as sulphates. It is doubtless thus that the natural deposits of carbonate of soda have been formed in many arid countries.

It is obvious that, as practically all soils in the arid region contain notable amounts of the carbonates of lime and magnesia, the presence or absence of carbonic acid must largely control the nature of the salts in the soil. Of these the sulphate is the one mainly concerned in the transformation, because the chlorid (common salt) cannot participate in the changes to the same extent on account of the easy solubility of the lime compound (calcium chlorid) formed when the exchange occurs. It is chiefly with the transformation of lime carbonate into sulphate (gypsum), and the corresponding production of carbonate of soda, that we are practically concerned. This is emphasized by the evident inverse relations of the two sodium salts (sulphate and carbonate), shown in the preceding diagram. It must not be forgotten that, although the analysis does not mention them, *carbonate of lime and gypsum* are always present in these alkali soils in varying amounts.

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*On the mutual reactions of carbonates, sulphates, and chlorids of the alkaline earths and alkalies. By E. W. Hilgard and A. H. Weber.

Carbonic acid can be formed in the soil in either of two ways: by the direct action of the air upon the vegetable matter of the soil, or by a fermentative process, out of contact with the air. The latter cause appears ordinarily to be the more efficient, at least in arid climates, where access of air usually implies at the same time a drying-out of the soil that greatly interferes with any effective accumulation of carbonic acid. It is mainly in the presence of abundant moisture, therefore, in the depths of the soil, that notable amounts of carbonic acid are found, rendering possible the formation of the carbonate of soda; unless, indeed, in times of rain or abundant irrigation, the moisture remains near the surface for some time.

It follows that, under natural conditions, the proportion of carbonate of soda in the salts should increase as we descend, so long as the presence of vegetable mould (humus) permits of the production of carbonic acid.

A glance at the percentage tables corresponding to diagrams Nos. 1 and 4 (*a* and *b*), shows that this is actually the case. In the two profiles last mentioned, which represent the effect of a whole summer's aëration and heating upon the salts brought up from below, the predominance of the sulphates is just as overwhelming as, in the case of No. 1, is that of the carbonate in the subsoil hardpan; and in the very same bore-hole, it will be seen that within the upper fifteen inches the sulphate and carbonate are nearly equal, while at forty-five inches the carbonate forms nearly the whole (94 per cent) of the salts.

We are now prepared to understand the cause of the singular zigzag variations of the two salts in Fig. 2*b*, more fully shown in Fig. 2*c*. Between the dates at which the samples for the tests represented by 2*a* and 2*b* were taken, there were several light, warm rains, amounting to nearly an inch of rainfall. Between times there was hot sunshine, which, in the moist ground, naturally produced a lively formation of carbonic acid. The zigzags evidently represent successive waves of moisture and heat, penetrating the soil from the surface downward, causing corresponding variations in the composition of the salts; the moister portions having the larger proportion of carbonate, the drier ones of sulphate.

This is in entire accordance with actual observations in the field, which show that:

1. On one and the same soil, the lower and moister ground shows more of "black" or carbonate alkali than the higher.
2. As between heavy or clayey, and light or sandy soils, in similar location, the sandy soil invariably shows less of "black" alkali than the denser clay soil.

Generally speaking, "black" alkali occurs mostly in (relatively) low or badly drained ground; the "white," on high or well drained ground.

The important practical conclusion to be drawn from these facts is, that whenever land is thoroughly aërated (as by underdrainage), there is little danger from "black" alkali; and if temporarily formed, it will soon vanish by transformation into the "white" or neutral salts; while whenever, on the contrary, alkali land is allowed to be water-soaked for any length of time, the neutral or "white" salts may be transformed into the corrosive carbonate, with all the bad effects of "black" alkali.

From the observations made it would seem that a large excess of gypsum in the soil will tend to retard materially the reversal of the beneficial transformation it may have effected in neutralizing the "black" alkali. But it is also well known, from old experience elsewhere, that a soil containing much gypsum is very liable to be seriously damaged by waterlogging, because of the "reduction" (of the sulphates to sulphides) which will result in the production of sulphuretted hydrogen—the gas of rotten eggs, so fatal to vegetation.

From all these considerations it is plain that in alkali soils, more, even, than in ordinary ones, the waterlogging or swamping of the land is liable to produce serious and, in some cases, permanent injury. And as most alkali lands are cultivated with irrigation, this is, unfortunately, but too liable to happen, whether from leaky ditches, that make the water rise from below, or from over-irrigation without any provision for drainage. The testimony from sufferers who have seen their orchards and vineyards ruined in this way, is but too abundant in many localities.

The fact that, in consequence of their natural retention of moisture, which is in part, at least, available to plants, alkali lands do not require as much irrigation as non-alkaline ones, is not sufficiently understood and appreciated. The vain endeavor to wash out the salts inclines many to give rather more than less water, which is especially noxious in case of the presence of hardpan.

In any case, however, after the use of gypsum, and the avoidance of swamping, the *prevention of evaporation* to the utmost possible extent is the fundamental requirement.

COUNTERACTING EVAPORATION.

From what has been said it is obvious that since *evaporation from the soil-surface is the cause of any "rise of the alkali,"* one of the chief preventive measures must be *the reduction of surface evaporation to the lowest possible point.* This can be done either by mulching or, less effectually, by shading.

The best mulch, available in all cases, is *a well and deeply tilled surface soil*, on which a crust is never allowed to form. Then evaporation will be reduced to the minimum, and whatever does take place leaves the alkali distributed through the whole of the tilled layer, instead of *at* the surface, where the bulk of the damage is usually done. For, a loosely tilled soil will take up little or no moisture from a denser or more compact subsoil, which it protects quite as effectually as would a straw mulch.

Of course, the depth or thickness of this protective tilled layer is of the utmost importance, not only for the sake of preventing evaporation and accumulation, but also because, since the maximum of alkali in irrigated land, at the end of the dry season, is always near the surface, the intermixing of the strong surface alkali with as large a mass of subsoil as possible, is important in order to dilute and diffuse it; so that it may not be strong enough anywhere to hurt the roots or root-crown. After such an intermixture, say to the depth of ten or twelve inches, it takes some time to bring the salts to the surface again to a sufficient extent to hurt the crop. An instinctive recognition of this principle has led cultivators of alkali soils in some cases to resort to sanding the surface, and with temporary good results.

But the mainstay in the cultivation of alkali land must always be *the maintenance of deep and loose tilth throughout the times when evaporation is active.* This implies the growing on them of hoed rather than grain crops, unless drill culture (which at present prices would hardly pay) were resorted to. The growing of corn, beans, beets, and possibly of cañaigre—always choosing preferably the deep-rooted crops—is therefore indicated; and experience at Chino has conclusively shown that the very best of beets may be grown on light alkali soils in which common salt is not too prominent.

"BLACK" AND "WHITE" ALKALI.

Deep and loose tillage, however, is practically impossible on lands tainted with any considerable amount of "*black*" alkali. It will remain cloddy, and will crust over even with dew, despite all cultivating, harrowing, and clod-crushing. The first need, therefore, is *the neutralization of the "black" alkali with gypsum*, by which operation other important benefits are also secured. The saving in cost of cultivation on heavier lands will alone soon pay for the purchase of the gypsum, aside from increased and improved products. It must always be remembered that little or no benefit is to be expected from gypsum in cases of purely "white," neutral alkali; but there are tens of thousands of acres of land now lying idle, lightly tainted with "black" alkali, that would be definitely reclaimed, and rendered profusely productive, by the use, once for all, of a ton of gypsum per acre. But it is not absolutely necessary to use the entire amount at once; it can also be done by annual installments of say five hundred pounds per acre, put in some time before the seed. The latter will thus be protected from being killed by the "black" alkali, and secure a stand to shade the ground, preventing an injurious rise of salts, for the season at least. It must be remembered, however, that *gypsum cannot act on alkali without water;* and that the action itself takes several weeks before immunity is secured, and continues for several months, and even longer.

The dressing of gypsum should therefore be applied in ample time before seeding, and after cultivating or plowing-in, should be promptly followed by irrigation, unless the rainy season can be relied upon to perform the service before seeding time. The smaller the seed to be sown, the more important is this precaution; beans, peas, or maize may remain unharmed where alfalfa, or other clover seeds, as well as those of meadow and pasture grasses, would perish either before or during germination.

One additional point should be emphasized here. It will be seen from the curve lines representing the individual salts—common and Glauber's salt, and sal soda—that the latter is proportionally most abundant in the clay hardpan (Plate 1), where it forms from 80 to over 90 per cent of the whole; while near the surface, in the very same bore-hole, it forms about 23 per cent only. This is due to the moisture and want of aëration in the subsoil, acting in a manner not easily explained in a popular way. But it may be taken for granted that whenever an alkali soil is subjected to the action of stagnant water, or of abundant moisture without aëration, the formation of "black" alkali will take place. This is the reason why the latter is most commonly found in low, moist ground, and in close, heavy soils; while on the higher ground adjacent, the white salts alone may prevail. The "swamping" of alkali lands is thus seen to be doubly pernicious; and the leaky ditches which cause it, should, for this reason alone, be considered a public nuisance.

ANALYSES OF SPECIMENS OF ALKALI.

Alkali crust, two samples: one from Southern California Experiment Station near Chino, sent by the foreman; the other from the Chino ranch, sent by Richard Gird. An analysis of the latter was also made by the chemist of the sugar refinery, and the results given below.

Analyses of Alkali Crusts from Chino, California.

	No. 1. Sample Sent by Foreman of Experiment Station.	No. 2. Sample Sent by R. Gird, Esq.	No. 3. Analysis by Chemist of Sugar Refinery.
* Potassium sulphate	3.97	2.56	40.10
Sodium sulphate (Glauber's salt)	49.58	80.41	27.92
Sodium carbonate (sal soda)	----------	4.50	----------
Sodium chlorid (common salt)	15.61	3.76	7.49
† Magnesium nitrate	11.63	1.29	----------
Magnesium sulphate (Epsom salt)	10.66	.23	3.21
Calcium sulphate (gypsum)	1.94	----------	----------
Organic matter and chemically comb. water (by diff.)	6.61	7.25	----------
Organic substance	----------	----------	3.34
Undetermined	----------	----------	17.94
Total	100.00	100.00	100.00
* Pounds per acre (1 foot deep)	444	218	----------
† Equivalent to Chile saltpeter, pounds per acre (1 foot deep)	1,500	131	----------

It is not easy to reconcile the results shown in the analysis of the samples from the Chino Ranch, which are said to be from the same spot; there are also differences between the first and second columns, the most notable being in the cases of Glauber's salt, the nitrates, and Epsom salt. Such differences, however, do occur in one and the same alkali spot, as shown in the investigations of Mr. Colemore (Report for 1894, p. 141).

The percentage of potassium sulphate given by the factory chemist is excessively large, and no similar one has been found elsewhere. The composition of the Chino alkali, as given in column two, is quite a usual one for "white" alkali, both as to contents of potassic sulphate and the nitrates. As regards the latter, it will be seen that the Station sample contains about ten times more than that of Chino. Beets planted on the former were among the smallest and least satisfactory on the ground, while upon the Chino spot the beets were of good size and rich in sugar. Calculated by pounds to the acre, one foot deep, the amounts of both potash and nitrates existing in the soil are something like the usual dressings applied to beets in Germany, while in the case of the Station soil there is great excess of nitrates.

Saltpeter, or "*Caliche*," from G. N. Apkins, Vista, San Diego County. It is said to have been found in the Colorado Desert, in the southeastern part of this State. It is rich in niter, and, if in large quantity, is a valuable deposit.

Alkali soil, from land on the Mojave River, San Bernardino County; sent by B. F. Taylor, of Rialto. The sample was taken 16 inches deep, and is a light silt, showing alkaline reaction. A portion of it was leached and examined, with the following result:

	In 100 Grains of Soil.	Percentage Composition of the Salt.
Sulphates of potash and soda	.110	11.11
Carbonate of soda	.270	27.27
Chlorid of sodium	.610	61.62
Total	.990	100.00

According to the general law of distribution of alkali in the soil there must be 5 or 6 per cent of the salt at or near the surface; or more than anything but an Australian saltbush can stand, provided the "black" alkali were neutralized by gypsum.

Alkali deposit, from 15 miles east of Rosamond, Kern County; sent by P. W. Darcy, of Los Angeles. The substance contains the following percentage of ingredients:

Sodium carbonate (sal soda)	15.06
Sodium chlorid (common salt)	2.20
Sodium sulphate (Glauber's salt), (small amount of potassium sulphate)	32.89
Water	49.79
	99.94

Alkali, from Oregon; sent by P. M. Scott, of San Francisco. The material contains 40 per cent of insoluble matter, consisting of carbonate of lime chiefly. The soluble part has the following percentage composition:

Carbonate of soda	35.00
Sodium chlorid	14.00
Sodium sulphate	6.70
Moisture at 100°	44.30
	100.00

If perfectly dried the salt would contain about 63 per cent of carbonate of soda, a portion of which, by proper methods, could easily be separated in quite a pure condition, while the rest would be contaminated with the other salts.

Alkali leachings, from a soil and subsoil on the place of H. A. P. Carter, Byron, Contra Costa County. The soil was taken 12 inches deep; the subsoil at 5 feet. "Will alfalfa grow on this land?"

Soluble Salts.	Amount in 100 Parts of	
	Soil.	Subsoil.
Potassium sulphate	.016	.005
Sodium sulphate	.109	.095
Sodium chlorid (common salt)	.064	.032
Sodium carbonate (sal soda)	.026	.015
Total soluble salts	.215	.147

The result shows a close approach to the limit, beyond which crops will not grow on a soil of this nature. So far as the surface soil is concerned, it would probably not hurt alfalfa, for it has been grown on land nearly as heavy and even more strongly impregnated with alkali. The trouble will come when the subsoil is reached by the tap-root, to penetrate which will be a hopeless job, at least so long as the carbonate of soda remains unchanged. What will happen was plainly shown in our attempt to leach the subsoil, when it soon, in spite of all precautions, collapsed into an almost impervious mush, from which in the course of ten days we obtained sufficient leaching for analysis. The use of gypsum is advised, which will neutralize the "black" alkali, and render the clay incapable of running together.

Alkali crust, from East Highlands, San Bernardino County; sent by E. T. Pierce. "This crust, grayish in color, appears near the flumes, on the surface of the soil, immediately after irrigation. The water used is from Bear Valley, and is very low at this time (December, 1894)." The crust is composed chiefly of sulphate and chlorid of sodium. No "black" alkali (carbonate of soda) or nitrates were found in the sample.

Alkali deposit and water; sent by J. Warren Dutton, Dutton's Landing. This deposit forms on the surface of the lower ground in the summer. The solid sample was whitish, partly crystalline, and partly granular lumps. On examination it proved to be almost pure sulphate of magnesia, with some gypsum. The water from the same place was very salty, with also a little carbonate of soda.

Alkali crust, from 3 miles south of Fresno; sent by J. Wells, of San Francisco. The sample was very strong in carbonate of soda ("black" alkali).

THE GROWING OF SUGAR BEETS ON ALKALI SOILS.

By E. W. Hilgard and R. H. Loughridge.

According to European experience, one would expect that alkali soil would be among the last to suit sugar-beet culture. It is almost a maxim that this culture cannot be successful on salty soils, since experience has shown that on such lands the sugar-content and the purity-coefficient of the juice will be low, while the content of ash and saline matters will be high. In California, also, this has been fully verified where the sugar beet has been grown on seacoast marsh lands; the best seed there produce roots with 5 to 6 per cent of sugar, and a purity that is 20° below tolerance. At the San Joaquin Valley Station, near Tulare, also the sugar-content and degree of purity proved unsatisfactory, wherever alkali was touched by the roots.

There was, it is true, no definite experience on record in regard to the effects of other saline substances than common salt. But it seemed at least probable that Glauber's salt and sal soda (sulphate and carbonate of soda) would also act unfavorably on the quality of the beet for sugar-making. The culture experiments made at the San Joaquin Valley Station, near Tulare, have confirmed this presumption in so far that high-grade roots have not been obtained thus far on the soil which is quite strongly impregnated, and alongside of sal soda and Glauber's salt contains a good deal of common salt, together with potash, phosphates, and saltpeter.

When the great sugar factory at Chino was established, I cautioned the owners of the ranch not to extend the beet fields too far toward the low ground, where every summer the alkali shows on the surface. At first, some attention was paid to this point, but the unusually high quality of the beets produced caused a rapid extension of the plantings, and the alkali question was forgotten. For two years past excellent roots have been grown quite near to some of the spots which show the largest amount of alkali in summer; and since 15 per cent of sugar is the standard percentage required, and the average for the year came very near to that mark, it was evident that no serious damage had been done by the alkali.

In 1894, for the first time, the ten-acre experimental plot, which lies on the border of the alkali land, could be properly cultivated and planted. Occasional small alkali spots could be seen on the tract, but its natural growth of tall grasses and vigorous sunflowers showed no damage therefrom. There was some little difficulty in getting the land into proper condition. The strong roots and grass tussocks had to be raked and harrowed out.

The rainfall of 1894 was an exceedingly short one; only eight inches of rain fell, to the great injury of the grain and hay crop, and as was to be expected, a good deal more alkali than usual came up in that year in consequence of evaporation. Alkali appeared on the surface where it had never before been seen, but it kept the soil sufficiently moist to permit of easy germination of the seed, and the little beet seedlings appeared to be perfectly at ease among the white salts on the surface.

The largest portion of the tract was sown with forage plants of various kinds: ray-grass, orchard-grass, maize, sorghum, tall oat grass, and others. Unexpectedly a light, late rain came after the sowing, but of the smaller seeds scarcely any germinated; of the grasses, maize and sorghum alone showed up fairly, but soon languished so that manifestly no crop was to be looked for. A large variety of legumes was also sown; almost all came up, but remained dwarfed; from the white clover to horse beans, none gave any promise of a crop.

Under these circumstances the greater part of the tract was again plowed, and on May 29th was sown to sugar beets. These came up quickly, though with a somewhat thin stand, right among the alkali efflorescences, and continued to grow without let or hindrance.

In the neighboring fields, also, the beets were doing finely, and, as in the previous year they had yielded excellent roots, it became of special interest to investigate the alkali salts, which, while leaving the beet root unscathed, had proved so injurious to grasses and legumes.

Nature and Composition of the Soil at Chino Station.—It will be proper to re-introduce in this place the description of the soil of this tract given in a former report (1890, page 38). The land is ancient alluvium, part of what once was the bed of a lake, and which is now traversed by Chino Creek, with but a slight fall. It lies at the foot of the great debris cone formed by San Antonio Creek in front of the cañon through which it issues from the Sierra Madre. The soil is a bluish-gray loam, mouse-colored when moist, and very deep, scarcely changing for ten or more feet, and remains moist during the summer; although easily worked under proper moisture conditions, it is injured by cultivation while very wet. The following analysis shows its mechanical and chemical composition:

No. 1284. *"Moist Adobe" Soil, Experiment Station, near Pomona.*

Coarse materials above 0.6 mm. in diameter	10.00
Fine earth	90.00

Chemical Analysis of Fine Earth.

Insoluble matter	62.62	70.92
Soluble silica	8.30	
Potash (K_2O)		.95
Soda (Na_2O)		.50
Lime (CaO)		5.07
Magnesia (MgO)		.84
Br. ox. of manganese (Mn_3O_4)		.06
Peroxid of iron (Fe_2O_3)		6.43
Alumina (Al_2O_3)		4.88
Phosphoric acid (P_2O_5)		.21
Sulphuric acid (SO_3)		.06
Carbonic acid (CO_2)		3.76
Water and organic matter		6.02
Total		99.70
Humus		1.99
Nitrogen per cent in humus		10.20
Nitrogen per cent in soil		.203
Ash		1.13
Soluble phosphoric acid		.03
Silica		.96
Hygroscopic moisture (absorbed at 15° C.)		5.81

Mechanical Analysis of Fine Earth.

Colloid clay		13.44
Silt	<0.25 mm. hydraulic value	20.65
	0.25 mm.	1.37
	0.5 mm.	4.91
	1.0 mm.	5.95
	2.0 mm.	13.46
Sand	4.0 mm.	10.36
	8.0 mm.	9.25
	16.0 mm.	12.01
	32.0 mm.	2.75
	64.0 mm.	1.66
		95.81
Water capacity		60.20

The mechanical analysis shows this soil to be a loam of easy tillage, of medium hygroscopic power, and water capacity unusually high. The latter property causes it to remain wet late in the season; but, fortunately, it can be plowed successfully while still containing a great deal of water, without material injury to tilth. It is apt to be boggy in wet seasons, as is indicated by its native growth of "yerba mansa" (*Anemopsis Californica*), a plant of the low grounds.

The chemical analysis shows the soil to be strongly calcareous, so that it effervesces ("boils") when touched with a drop of acid. Its content of magnesia is not large; it is rich in reserve plant-food (zeolites or easily decomposable silicates), as well as in phosphoric acid and potash. Its humus-content is high for California, and the nitrogen-content of the same is about the average for virgin soils in low ground in the arid region. The aggregate nitrogen-percentage is large, and the soil is, as a whole, therefore, a rather exceptionally rich one.

Contents of Soluble Salts or Alkali.—In leaching the soil, considerable differences are found in the contents of salts, which, at the time of taking the samples (October, 1894), ranged from .032 per cent to .322 per cent of the air-dried soil. The latter figure, according to European experience, is above the full maximum (.250 per cent) compatible with growing of useful crops on *brackish* lands.

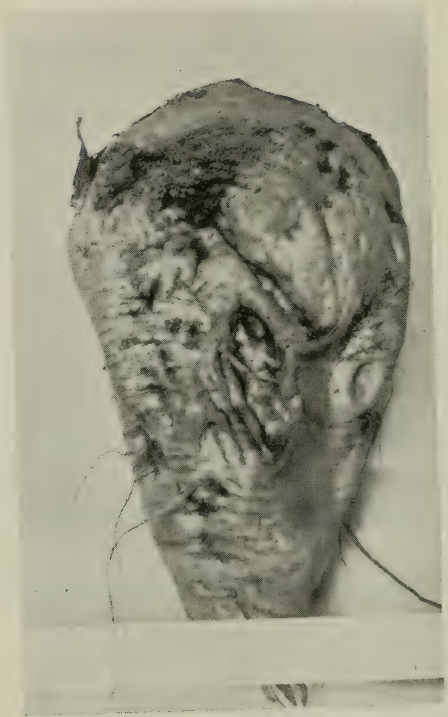
The analyses of the leachings of soil samples from different portions of the tract showed such wide differences in their chemical composition, that it was manifestly impracticable to draw definite conclusions from indiscriminate planting of the entire area. It was clearly necessary to discriminate between its different portions, as representing both different amounts and qualities of alkali salts, in order to deduce any definite conclusions regarding the tolerance of different plants for the several mixtures of salts. On consideration it was thought best to survey the tract into parcels of fifty feet square, each to be sampled in the middle; thus gaining data for the construction of an "alkali map," on the basis of which accurate comparisons would become possible. Since each one of the one hundred and sixty-nine squares thus laid out would require leaching and full analysis, it was not expected to cover the entire series in one year. The portion thus far covered by analyses is represented in the subjoined tabular diagram, in which the mainly important saline ingredients are inscribed within each square sampled, for greater convenience of comparison. A fuller statement of the results of the analysis is given in the annexed table. The samples were taken twelve inches deep. The sulphates are designated by the letter S, the carbonates by C, the chlorids by Cl, and the nitrates (chiefly of magnesia) by N. The first column in each square gives the parts in 100 of soil, and the second column parts in 100 of alkali salts, while the last division gives the amounts per acre.

ANALYSES OF LEACHINGS OF ALKALI SOILS, FROM THE TEN-ACRE TRACT OF EXPERIMENT STATION.

Number of Plot.	In 100 Parts of Soil.						In 100 Parts of Soluble Salts.					Total Amount of Salts per Acre.					
	Alkali Sulphates	Sodium Carbonate	Sodium Chlorid	Magnesia Nitrate	Magnesia Sulphate	Total Soluble Salts	Alkali Sulphates	Sodium Carbonate	Sodium Chlorid	Magnesia Nitrate	Magnesia Sulphate	Alkali Sulphates	Sodium Carbonate	Sodium Chlorid	Magnesia Nitrate	Magnesi Sulphate	Total Soluble Salts
												lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1	.033	.076	.002	.002	--------	.113	29.2	67.2	1.8	1.8	--------	1,320	3,040	80	80	--------	4,520
3	.067	.042	.016	.029	--------	.154	43.6	27.2	10.4	18.8	--------	2,480	1,680	640	1,160	--------	6,160
5	.137	--------	.058	.066	.027	.288	47.6	--------	20.1	22.9	9.4	5,480	--------	2,320	2,640	1,080	11,520
7	.172	.035	.023	.036	.051	.317	54.2	11.0	7.2	11.3	16.3	6,880	1,400	920	1,440	2,040	12,680
8	.041	.084	.082	.008	.018	.233	17.6	36.0	35.2	3.5	7.7	1,640	3,360	3,280	320	720	9,320
9	.052	--------	.017	.126	--------	.195	26.7	--------	8.7	64.6	--------	2,080	--------	680	5,040	--------	7,800
10	.064	--------	--------	.077	--------	.141	45.4	--------	--------	54.6	--------	2,460	--------	--------	3,080	--------	5,640
12	.034	.042	--------	.002	.018	.096	35.4	43.8	--------	20.8	--------	1,360	1,680	--------	80	720	3,840
17	.010	.026	.034	.040	--------	.110	9.1	23.6	30.9	36.4	--------	400	1,040	1,360	160	--------	4,400
19	.016	.013	.012	.016	.006	.063	25.4	20.6	19.1	25.4	9.5	640	520	480	640	240	2,520
24	.136	.037	.004	.023	.007	.207	65.7	17.8	1.2	12.0	3.3	5,440	1,480	160	920	280	8,280
26	.059	.032	.009	.007	--------	.107	55.1	29.9	8.5	6.5	--------	2,360	1,280	360	280	--------	4,280
27	.093	.042	.015	.007	.014	.171	54.3	24.5	8.7	4.4	8.1	3,720	1,680	600	280	560	6,840
31	.139	.011	.023	.009	.054	.236	58.9	4.6	9.7	4.6	22.2	5,560	440	920	360	2,160	9,440
33	.069	.042	.023	.033	.054	.221	31.2	19.0	10.4	15.0	24.4	2,760	1,680	920	1,320	2,160	8,840
35	.044	.053	--------	.056	--------	.153	28.8	34.6	--------	36.6	--------	1,760	2,120	--------	2,240	--------	6,120
38	.073	.027	.012	.029	.009	.150	48.7	18.0	8.0	19.3	6.0	2,920	1,080	480	1,160	360	6,000
43	.072	.027	.014	.028	--------	.161	44.7	16.7	21.3	17.3	--------	2,880	1,080	560	1,120	--------	6,440
47	.082	.034	.013	.018	--------	.147	55.7	23.1	8.8	12.4	--------	3,280	1,360	520	720	--------	5,880
50	.033	.063	.023	--------	--------	.119	27.7	53.0	19.3	--------	--------	1,320	2,520	920	--------	--------	4,760
52	.014	.053	.012	.014	--------	.093	15.1	57.0	12.9	15.0	--------	560	2,120	480	560	--------	3,720
53	.179	.050	.038	.042	.010	.322	55.5	15.5	11.8	13.0	4.2	7,160	2,000	1,520	1,680	400	12,880
55	.096	.066	.012	.023	--------	.197	48.7	33.5	6.2	11.6	--------	3,840	2,640	480	920	--------	7,880
57	.077	.057	.014	.020	--------	.168	45.8	33.8	8.6	11.8	--------	3,080	2,280	560	800	--------	6,720
60	.088	.074	.012	.030	--------	.204	43.1	36.3	5.9	14.7	--------	3,520	2,960	480	1,200	--------	8,160
63	.048	.030	.019	.018	.013	.128	37.5	23.4	14.8	14.0	10.3	1,920	1,200	760	720	520	4,920
67	.044	.021	.012	.032	--------	.109	40.4	19.3	11.0	29.3	--------	1,760	840	840	1,280	--------	4,360
69	.082	.057	.012	.034	--------	.185	44.3	30.8	6.5	18.4	--------	3,280	2,280	480	1,360	--------	7,400
72	.073	.032	.012	.020	--------	.137	53.3	23.3	8.4	15.0	--------	2,920	1,280	480	800	--------	5,480
74	.089	.006	.035	.071	--------	.201	44.3	3.0	17.4	35.3	--------	3,560	240	1,400	2,840	--------	8,040
78	.096	.016	.012	.016	--------	.140	68.6	11.4	8.6	11.4	--------	3,840	640	480	640	--------	5,600
81	.048	.058	.005	.003	--------	.114	42.1	50.8	4.3	2.8	--------	1,920	2,320	200	120	--------	4,560
83	.043	.021	.009	.023	--------	.096	44.8	21.8	9.5	23.9	--------	1,720	840	360	920	--------	3,840

ANALYSES OF LEACHINGS OF ALKALI SOILS, FROM THE TEN-ACRE TRACT OF EXPERIMENT STATION—Continued.

Number of Plot.	In 100 Parts of Soil.						In 100 Parts of Soluble Salts.					Total Amount of Salts per Acre.					
	Alkali Sulphates	Sodium Carbonate	Sodium Chlorid	Magnesia Nitrate	Magnesia Sulphate	Total Soluble Salts	Alkali Sulphates	Sodium Carbonate	Sodium Chlorid	Magnesia Nitrate	Magnesia Sulphate	Alkali Sulphates	Sodium Carbonate	Sodium Chlorid	Magnesia Nitrate	Magnesia Sulphate	Total Soluble Salts
												lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
85	.051	.042	--------	.013	--------	.106	48.1	39.6	--------	12.3	--------	2,040	1,680	--------	520	--------	4,240
87	.022	.038	--------	.007	--------	.067	32.8	56.7	--------	10.5	--------	880	1,520	--------	280	--------	2,680
93	.030	.034	.005	.011	--------	.080	37.5	42.5	6.3	13.7	--------	1,200	1,360	200	440	--------	3,200
95	.031	.059	.002	.005	--------	.097	31.9	60.8	2.2	5.1	--------	1,240	2,360	80	200	--------	3,880
97	.070	.042	.012	.015	--------	.139	50.3	30.2	8.7	10.8	--------	2,800	1,680	480	600	--------	5,560
99	.055	.021	.009	.041	--------	.126	43.6	16.0	7.9	32.5	--------	2,200	840	360	1,640	--------	5,040
101	.042	.038	.005	.021	--------	.106	39.6	35.8	4.8	19.8	--------	1,680	1,520	200	840	--------	4,240
103	.136	--------	.012	.066	--------	.214	63.5	--------	5.6	30.9	--------	5,440	--------	480	2,640	--------	8,560
107	.124	.072	.009	.040	--------	.245	50.6	29.3	3.8	16.3	--------	4,960	2,880	360	1,600	--------	9,800
109	.028	.034	.002	.025	--------	.089	31.4	38.2	2.3	28.1	--------	1,120	1,360	80	1,000	--------	3,560
111	.045	.032	.005	.021	--------	.103	43.6	31.0	5.1	20.8	--------	1,800	1,280	200	840	--------	4,120
113	.026	.019	.002	.004	.010	.061	42.6	31.1	3.2	6.4	16.7	1,040	760	80	160	400	2,440
115	.025	.008	.002	.006	.013	.054	46.2	14.8	3.9	11.1	24.0	1,000	320	80	240	520	2,160
118	.085	.024	.020	.053	--------	.182	46.7	13.2	11.0	29.1	--------	3,400	1,000	800	2,120	--------	7,280
121	.039	.015	--------	.007	.007	.061	63.9	13.3	--------	11.4	11.4	1,560	600	--------	280	280	2,440
123	.061	.021	.002	.031	--------	.115	53.0	18.2	1.9	26.9	--------	2,440	840	80	1,240	--------	4,600
127	.049	.025	.009	.033	--------	.116	42.2	21.5	7.9	28.4	--------	1,960	1,000	360	1,320	--------	4,640
129	.110	.016	.026	.066	--------	.218	50.5	7.3	11.9	30.3	--------	4,400	640	1,040	2,640	--------	8,720
133	.059	.059	.009	.020	--------	.147	40.1	40.1	6.2	13.6	--------	2,360	2,360	360	800	--------	5,880
135	.022	.047	--------	.015	--------	.084	26.1	55.9	--------	18.0	--------	880	1,880	--------	600	--------	3,360
136	.024	.023	.005	--------	--------	.052	46.1	44.2	9.7	--------	--------	960	920	200	--------	--------	2,080
139	.017	.013	--------	.002	--------	.032	53.1	40.6	--------	6.3	--------	680	520	--------	80	--------	1,280
141	.028	.021	--------	.011	.014	.074	37.8	28.3	--------	5.5	18.9	1,120	840	--------	440	560	2,960
145	.012	.017	.002	.002	--------	.033	36.3	51.5	6.1	6.1	--------	480	680	80	80	--------	1,320
149	.091	.051	.005	.021	--------	.168	54.1	30.3	3.1	12.5	--------	3,640	2,040	200	840	--------	6,720
151	.026	.038	.004	.005	.007	.080	42.5	37.5	5.0	6.2	8.8	1,040	1,520	160	200	280	3,200
153	.039	.055	.009	.010	.010	.123	31.7	45.1	7.0	8.1	8.1	1,560	2,200	360	400	400	4,920
158	.069	.053	.033	.031	--------	.186	37.1	28.5	17.7	16.7	--------	2,760	2,120	1,320	1,240	--------	7,440
161	.038	.047	.002	.028	--------	.115	33.0	40.8	1.9	24.3	--------	1,520	1,880	80	1,120	--------	4,600
163	.016	.013	.005	.024	--------	.058	27.6	23.9	7.2	41.3	--------	640	520	200	960	--------	2,320
165	.032	.047	.002	.009	.007	.097	32.9	48.3	2.4	9.2	7.2	1,280	1,880	80	360	280	3,880
167	.027	--------	--------	--------	.015	.042	64.2	--------	--------	--------	35.8	1,080	--------	--------	--------	600	1,680
Rincon	.018	.011	--------	.014	--------	.043	41.8	25.5	--------	32.7	--------	720	440	--------	560	--------	1,720



SUGAR-BEET GROWN ON A NITER SPOT (PLOT 9), SOUTHERN CALIFORNIA EXPERIMENT STATION.
(Reduced to one third.)

Even a passing glance at the columns of the above table shows surprising variations in the composition of the salts in plots not very far apart, and considering the smallness of the tract, very surprising ones in those remote from each other. In some cases (e. g., Nos. 1, 8, 50, and 60) we find alkali of the "blackest" kind, having above 2,000 pounds of carbonate of soda per acre; in others, we find them almost rigorously "white"; that is, consisting of neutral salts, and almost destitute of carbonate of soda, which forms the predominant ingredient in the "black" alkali. Take it all in all, Glauber's salt (sulphate of soda) may, roughly speaking, be said to predominate in the tract as a whole, while common salt (sodium chlorid) is mostly quite subordinate, rarely reaching as much as one third of the total. No wonder, therefore, that this land should behave differently from brackish seashore lands, in which common salt is altogether predominant, and forbids the growth of crops which feel perfectly at home on Chino soil.

The most remarkable feature, however, is the almost universal presence of nitrates, sometimes to the extent of over one half of the total salt. In this respect, this land exceeds any or all heretofore examined by us. In some cases, the total amount of saltpeter in the soil within the two or three feet which the roots penetrate, is such as to exceed, many times over, any fertilizing application ever made. Thus, in plot No. 9, nearly two tons per acre would be contained in the first foot, and fully 5,500 pounds within the first three feet; being about thirty times the amount of Chile saltpeter ever used in artificial fertilization. In this particular plot, the excess proved to be so great, that the sugar beets grown on it were useless for sugar-making purposes, being overgrown and sappy, and lacking sweetness to a notable degree; the well-known effect of an excess of nitrogenous fertilizers. The accompanying plate shows one of these roots weighing 2.5 pounds, grown on this soil, and yielding only 10 per cent of sugar in the juice, with a purity-coefficient of 67; while the general average weight elsewhere did not exceed 400 grams (462 to the pound), and the average sugar-content of the whole crop sold to the factory from this entire tract was 15.5 per cent, with purity between 85 and 90.

Aside from the nitrates, all the leachings contained a not inconsiderable proportion of potash sulphate, ranging from about 1 to 7½ per cent of the total salts, and constituting altogether a supply likely to last, even with heavy cropping, for many years. As regards phosphates, it will be seen that as usual in "white" or neutral alkali, they are not found in solution in the leachings to any great extent; except (again, as usual) in the cases where the carbonate or "black" alkali forms a prominent ingredient.

Distribution of the Salts.—There is a slight swell or low ridge on the land running through the central part of the tract from plot 4 on the northeast, to plot 174 on the southwest. To the east of this ridge the drainage is to the southeast; on the west the drainage is nearly parallel with the ridge at a short distance from it, the flow being perceptible from northeast to southwest.

It was at first supposed that this elevation or water-divide would affect the amounts of alkali on either side; especially as, to the northward of the tract, there is a large sink or hole in which stable manure has been dumped for a number of years, and which must have yielded some of its ingredients to the surrounding soils. The following summary of averages of the analyses of soils on the swell, and on the east and west respectively, shows, however, that the average percentage of alkali salts is even greater on the east than on the west, and that on the swell itself they are still greater:

Average Percentage of Alkali Salts.

	Alkali Sulphates.	Carbonate.	Chlorid.	Nitrate.	Total.
On east of swell	.060	.044	.011	.022	.137
On the swell	.076	.036	.010	.025	.147
West of swell	.051	.029	.013	.026	.119
General average	.059	.035	.012	.025	.131

The *carbonates* are greatest on the east of the elevation, but otherwise vary very little from the general average of .035.

The *sulphates* are greatest on the elevation itself, while the *nitrates* are a little above the average of .025 on the west and to the west.

The general averages of each salt for the entire tract, so far as ascertained, are given in the last column, the total per acre being more than two tons of soluble alkali salts.

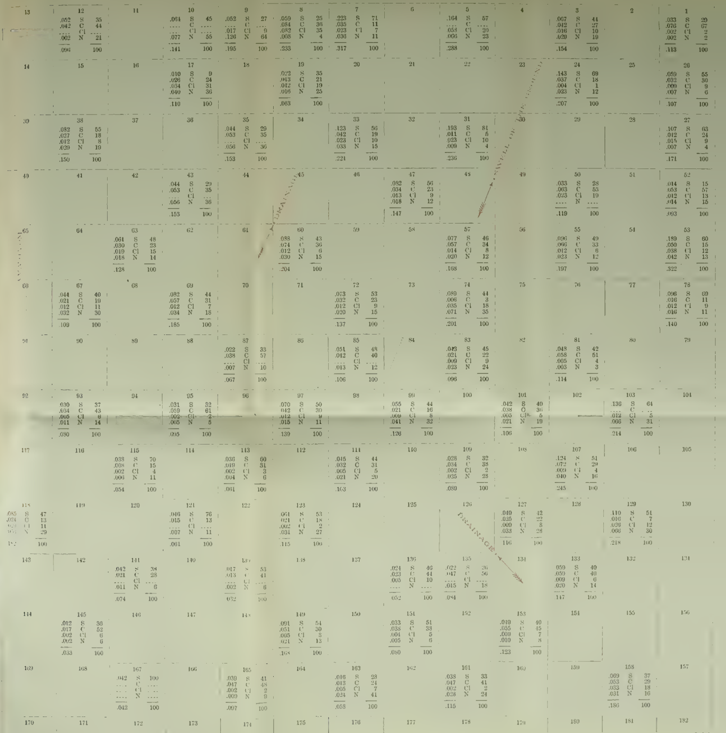
If, however, we compare the north and south portions of the tract, we find very material differences; ranging from the maximum totals of .317 on the north, to that of .186 on the south; a minimum of .096 on the north to .027 on the south, with corresponding intermediate grades from north to south.

Taking the averages of the lots thus far examined in the upper five rows, the middle three rows, and the lower five rows, respectively, we obtain the following results:

ANALYSES OF ALKALI IN THE TEN-ACRE TRACT, CHINO RANCH, SOUTHERN CALIFORNIA EXPERIMENT STATION.

Figures on the left in each plat show percentages in the soil; those on the right, percentage composition of salts. S—Sulphates of Alkalies and Magnesia; C—Carbonate of Soda; Cl—Chlorid of Sodium; N—Nitrates of Magnesia and Soda.

NORTH.



13

12
.052 S 35
.042 C 44
.... Cl ....
.002 N 21
.096 100

11

10
.064 S 45
.... C ....
.... Cl ....
.077 N 55
.141 100

9
.052 S 27
.... C ....
.017 Cl 9
.126 N 64
.195 100

8
.059 S 25
.084 C 36
.082 Cl 35
.008 N 4
.233 100

7
.223 S 71
.035 C 11
.023 Cl 7
.036 N 11
.317 100

6

5
.164 S 57
.... C ....
.058 Cl 20
.066 N 23
.288 100

4

3
.067 S 44
.042 C 27
.016 Cl 10
.029 N 19
.154 100

2

1
.033 S 29
.076 C 67
.002 Cl 2
.002 N 2
.113 100

14

15

16

17
.010 S 9
.026 C 24
.034 Cl 31
.040 N 36
.110 100

18

19
.022 S 35
.013 C 21
.012 Cl 19
.016 N 25
.063 100

20

21

22

23

24
.143 S 69
.037 C 18
.004 Cl 1
.023 N 12
.207 100

25

26
.059 S 55
.032 C 30
.009 Cl 9
.007 N 6
.107 100

39

38
.082 S 55
.027 C 18
.012 Cl 8
.029 N 19
.150 100

37

36

35
.044 S 29
.053 C 35
.... Cl ....
.056 N 36
.153 100

34

33
.123 S 56
.042 C 19
.023 Cl 10
.033 N 15
.221 100

32

31
.193 S 81
.011 C 5
.023 Cl 10
.009 N 4
.236 100

30

29

28

27
.107 S 63
.012 C 24
.015 Cl 9
.007 N 4
.171 100

40

41

42

43
.044 S 20
.053 C 35
.... Cl ....
.056 N 36
.153 100

44

45

46

47
.082 S 56
.034 C 23
.013 Cl 9
.018 N 12
.147 100

48

49

50
.033 S 28
.063 C 53
.023 Cl 19
.... N ....
.119 100

51

52
.014 S 15
.053 C 57
.012 Cl 13
.014 N 15
.093 100

65

64

63
.061 S 48
.030 C 23
.019 Cl 15
.018 N 14
.128 100

62

61

60
.088 S 43
.074 C 36
.012 Cl 6
.030 N 15
.204 100

59

58

57
.077 S 46
.057 C 34
.014 Cl 8
.020 N 12
.168 100

56

55
.096 S 49
.066 C 33
.012 Cl 6
.023 N 12
.197 100

54

53
.189 S 60
.050 C 15
.038 Cl 12
.042 N 13
.322 100

66

67
.044 S 40
.021 C 19
.012 Cl 11
.032 N 30
.109 100

68

69
.082 S 44
.057 C 31
.012 Cl 7
.034 N 18
.185 100

70

71

72
.073 S 53
.032 C 23
.012 Cl 9
.020 N 15
.137 100

73

74
.089 S 44
.006 C 3
.035 Cl 18
.071 N 35
.201 100

75

76

77

78
.096 S 69
.016 C 11
.012 Cl 9
.016 N 11
.140 100

91

90

89

88

87
.022 S 33
.038 C 57
.... Cl ....
.007 N 10
.067 100

86

85
.051 S 48
.042 C 40
.... Cl ....
.013 N 12
.106 100

84

83
.043 S 45
.021 C 22
.009 Cl 9
.023 N 24
.096 100

82

81
.048 S 42
.058 C 51
.005 Cl 4
.003 N 3
.114 100

80

79

92

93
.030 S 37
.034 C 43
.005 Cl 6
.011 N 14
.080 100

94

95
.031 S 32
.059 C 61
.002 Cl 2
.005 N 5
.095 100

96

97
.070 S 50
.042 C 30
.012 Cl 9
.015 N 11
.139 100

98

99
.055 S 44
.021 C 16
.009 Cl 8
.041 N 32
.126 100

100

101
.042 S 40
.038 C 36
.005 Cl 5
.021 N 19
.106 100

102

103
.136 S 64
.... C ....
.012 Cl 5
.066 N 31
.214 100

104

117

116

115
.038 S 70
.008 C 15
.002 Cl 4
.006 N 11
.054 100

114

113
.036 S 60
.019 C 31
.002 Cl 3
.004 N 6
.061 100

112

111
.045 S 44
.032 C 31
.005 Cl 5
.021 N 20
.103 100

110

109
.028 S 32
.034 C 38
.002 Cl 2
.025 N 28
.089 100

108

107
.124 S 51
.072 C 29
.009 Cl 4
.040 N 16
.245 100

106

105

118
.085 S 47
.024 C 13
[illegible] Cl 11
[illegible] N 29
[illegible] 100

119

120

121
.046 S 76
.015 C 13
.... Cl ....
.007 N 11
.061 100

122

123
.061 S 53
.021 C 18
.002 Cl 2
.031 N 27
.115 100

124

125

126

127
.049 S 42
.025 C 22
.009 Cl 8
.033 N 28
.116 100

128

129
.110 S 51
.016 C 7
.026 Cl 12
.066 N 30
.218 100

130

143

142

141
.042 S 38
.021 C 28
.... Cl ....
.011 N 6
.074 100

140

139
.017 S 53
.013 C 41
.... Cl ....
.002 N 6
.032 100

138

137

136
.024 S 46
.023 C 44
.005 Cl 10
.... N ....
.052 100

135
.022 S 26
.047 C 56
.... Cl ....
.015 N 18
.084 100

134

133
.059 S 40
.059 C 40
.009 Cl 6
.020 N 14
.147 100

132

131

144

145
.012 S 36
.017 C 52
.002 Cl 6
.002 N 6
.033 100

146

147

148

149
.091 S 54
.051 C 30
.005 Cl 3
.021 N 13
.168 100

150

151
.033 S 51
.038 C 38
.004 Cl 5
.005 N 6
.080 100

152

153
.049 S 40
.055 C 45
.009 Cl 7
.010 N 8
.123 100

154

155

156

169

168

167
.042 S 100
.... C ....
.... Cl ....
.... N ....
.042 100

166

165
.039 S 41
.047 C 48
.002 Cl 2
.009 N 9
.097 100

164

163
.016 S 28
.013 C 24
.005 Cl 7
.024 N 41
.058 100

162

161
.038 S 33
.047 C 41
.002 Cl 2
.028 N 24
.115 100

160

159

158
.069 S 37
.053 C 29
.033 Cl 18
.031 N 16
.186 100

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ADDITIONAL PROXIMATE ANALYSES OF CITRUS FRUITS. (SAMPLES SENT BY GROWERS FOR ANALYSIS.)

Number	Variety.	Place of Production.	Sender, or Grower.	Date of Receipt and Analysis.	Physical Analysis.					Proximate Analysis.			Analysis of Juice.				Whole Fruit.
					Average Weight, in grams	Rind—per cent	Pulp, Pressed — per cent	Seeds—per cent	Average Juice, in cubic centimeters	Water—per cent	Organic Matter—per cent	Ash—per cent	Solid Contents, by Spindle—per cent	Total Sugars (Inversion)—per cent	Cane Sugar (Polariscope)—per cent	Citric Acid—per cent	Total Nitrogen—per cent
	Oranges.																
114	Improved Navel	Duarte	A. C. Thompson.	June 14, 1894	260.0	27.20	36.30		92.0				16.20	12.55		.71	
115	Navel; fertilizer, nitrogen and phosphoric acid; *no potash;* average of two analyses	Riverside	D. L. Wilbur	March 18, 1895	267.8	31.56	30.97		97.5	85.0	14.64	.36	12.40	11.56	6.17	1.00	.199
116	Navel; fertilizer, nitrogen, phosphoric acid, and *1 lb. potash, per tree;* average of two analyses	Riverside	D. L. Wilbur	March 18, 1895	267.0	30.24	34.50		96.6	84.2	15.42	.38	13.70	12.51	6.73	1.00	.187
117	Australian Navel (No. 1); fertilizer, barnyard manure	North Pomona.	F. L. Palmer	May 6, 1895	190.0	41.00	25.70		55.0				13.80	10.37		1.75	.184
118	Australian Navel (No. 2); fertilizer, none				153.0	37.80	20.30		50.0				15.15	12.22		1.96	.175
119	Australian Navel (No. 3); fertilizer, nitrate of soda				160.0	39.40	26.00		55.0				13.65	10.18		1.82	.170
120	Australian Navel (No. 4); fertilizer, superphosphate (base, bone-black)				193.0	43.20	22.20		65.0				13.80	10.31		1.82	.171
121	Australian Navel (No. 5); fertilizer, muriate of potash				205.0	38.20	30.00		58.0				14.40	12.20		1.40	.158
122	Australian Navel (No. 6); fertilizer, nitrogen and phosphoric acid				160.0	39.20	25.00		48.0				13.90	11.24		1.51	.184
123	Australian Navel (No. 8); fertilizer, nitrogen and potash				208.0	34.70	26.20		70.0				13.30	10.38		1.27	.185
124	Australian Navel (No. 9); fertilizer, potash and phosphoric acid				208.0	34.80	27.40		68.0				13.30	10.10		1.20	.182
125	Australian Navel (No. 10); fertilizer, nitrogen, phosphoric acid, and potash				173.0	40.90	21.20		55.0				15.05	11.79		1.96	.183
128	Tardive	Pomona	Univ. Expt. Sta.	June 23, 1895	208.0	27.50	27.50		83.3				11.40	8.30		1.03	
129	Valencia Late	Pomona	Univ. Expt. Sta.	June 23, 1895	280.0	29.90	28.10		100.0				11.20	8.30		.98	
	Lemons.																
130	Villa Franca	Pomona	Univ. Expt. Sta.	June 23, 1895	171.0	46.20	24.50		43.3				10.00	2.50		5.47	
	Limes.																
131	Seedless (Tahiti)	Porterville	J. F. Bearss	Dec. 11, 1894	117.0	20.80	23.00		60.0				9.70	3.48		5.18	
	Pomelos.																
126	Triumph		W. C. Fuller	May 13, 1895	440.0	23.10	25.40	3.4	175.0				11.20	8.00		2.31	
127	Seedling		W. C. Fuller	May 13, 1895	430.0	30.70	29.50	3.4	138.0				10.00	6.84		2.00	

DISTRIBUTION OF ALKALI SALTS IN THE TEN-ACRE TRACT.

	In 100 Parts of Soil.					In 100 of Alkali Salts.				Amounts per Acre.				
	Sulphate	Carbonate	Chlorid	Nitrate	Total Soluble Salts.	Sulphate	Carbonate	Chlorid	Nitrate	Sulphate	Carbonate	Chlorid	Nitrate	Total Soluble Salts.
										lbs.	lbs.	lbs.	lbs.	lbs.
Upper five rows	.074	.038	.019	.029	.160	46.2	23.7	12.0	18.1	2,960	1,520	760	1,160	6,400
Middle three rows	.059	.034	.010	.025	.128	46.0	26.6	8.5	19.5	2,360	1,360	400	1,000	5,120
Lower five rows	.045	.031	.007	.019	.102	44.1	30.4	7.0	18.6	1,800	1,240	280	760	4,080
Average for the entire tract	.059	.035	.012	.025	.131	45.0	26.7	9.3	19.0	2,360	1,400	480	1,000	5,240

In this table we readily notice the diminishing amounts of salts, both total and individual, from north to south—the general average amount per acre being 6,400 pounds on the north, 5,120 pounds in the middle, and 4,080 pounds on the south; with a general average of 5,240 pounds for the entire tract.

The probable influence of the manure sink on the north is thus indicated; but especially by the fact that almost the highest total salts (.317), the highest of the nitrates (.126), of the carbonates (.084), and of chlorids (.082), respectively, for all the lots, are found in those closely adjoining the sink, and directly in line with its drainage.

So far as the distribution of the respective individual salts is concerned, we find the following general result:

The *carbonate of soda*, or "black" alkali, has a general average of .035 per cent, or 1,400 pounds per acre; more than one fourth of the total salts. It is highest on the north, though in many of the plots on the south the amount is almost as high as the majority of the former examined; and very many plots in both regions have amounts far below the general average of .035 per cent, or 1,400 pounds per acre. The five maximum amounts (all above .060 per cent) are, in the order of highest to lowest, on lots 8, 1, 60, 107, 55, and 50, in the northern part of the tract.

The *nitrate of magnesia* is generally highest in the northern lots, with its maximum of .126 per cent, or 5,040 pounds per acre, in lot No. 9. Of the sixty-five lots examined, there are nine in which the percentage of nitrate is above .05 per cent, or one ton per acre, viz.: Nos. 9, 10, 74, 5, 103, 118, 129, 35, and 103. The general average of all is .025 per cent, or 1,000 pounds per acre, and twenty-four of the sixty-five lots examined contain above this average. As it cannot be assumed, owing to the distribution of the drainage, that the abundant nitrates, found to the eastward of the ridge, are also derived from the manure pit, they must have been formed from the humus of the soil itself, under the extraordinarily favorable conditions offered for nitrification. This conclusion is confirmed by the existence of nitrates on other lands of the same region outside of the tract.

The *sulphates of the alkalies* have a general average of .059 per cent, or 2,360 pounds per acre. Twenty-nine of the plots contain above this average, and all but a few of these are in the northern part of the tract, showing that the sulphates preponderate in that region. The plot containing the maximum percentage (.189) in the soil is No. 53, and shows an average of 7,560 pounds per acre. This is one of the special beet plots on the side of the tract.

No gypsum had been used on any of the tract during the year 1894. It must be remembered, however, that (as we have shown elsewhere, see page 65) the alkali sulphate may be changed to carbonate by exchange with the carbonate of lime under the influence of long-continued moisture and warmth, so that the sulphate may vary inversely as the carbonate at different times within the same season.

The *chlorid of sodium* is least of all the alkali ingredients in the soil, its general average being .012 per cent, or 480 pounds per acre. Ten of the plots examined contained only traces of it, while in thirty the percentage was equal to or above the average. Here, too, we find the greatest proportion in the northern part of the tract, possibly influenced by drainage from the manure sink.

Distribution of Alkali Salts Downward.—Before many of the plots had been examined, three were selected for analysis to ascertain the variation in the several ingredients to depths lower than the twelve-inch samples of the main series. The samples of these three, Nos. 5, 9, and 74, were taken as averages of every three inches for the first foot, of six inches for the second foot, and of the third foot as a whole. They were leached as usual, and the solutions of alkali examined; with the results shown in the accompanying table and in the diagrams. The samples were taken in April, after the leaching winter rains had unfortunately lessened somewhat the amounts of the soluble alkali salts in the soils, that appeared in the October samples.

In the diagrams the depths are shown by horizontal lines at intervals of three inches, as marked on the margin to the left; while the unbroken *vertical* lines represent differences of two hundredths of one per cent in the saline contents of the soil-layers, as marked at the top of the diagram; increasing from left to right. The points in each soil-layer are then connected by lines.

In the tables, the first division gives the percentage in the soil, or parts per 100; the second division, the parts per 100 of alkali salts; while the last division gives the amounts of each salt found in an acre of the soil, whose average weight to a depth of one foot is placed at 4,000,000 pounds.

A glance at the diagram will serve to show that in each of the series the alkali salts very largely predominate in the upper foot—59 per cent in No. 5, 58 per cent in No. 74, and 75 per cent in No. 9 (causing the lines to reach far to the right)—while in the third foot the amount was very small. As in the case of the Tulare soils, it is very evident that cultivation has caused the salts to rise into the surface foot, where they form from .059 to .234 per cent of the soil.

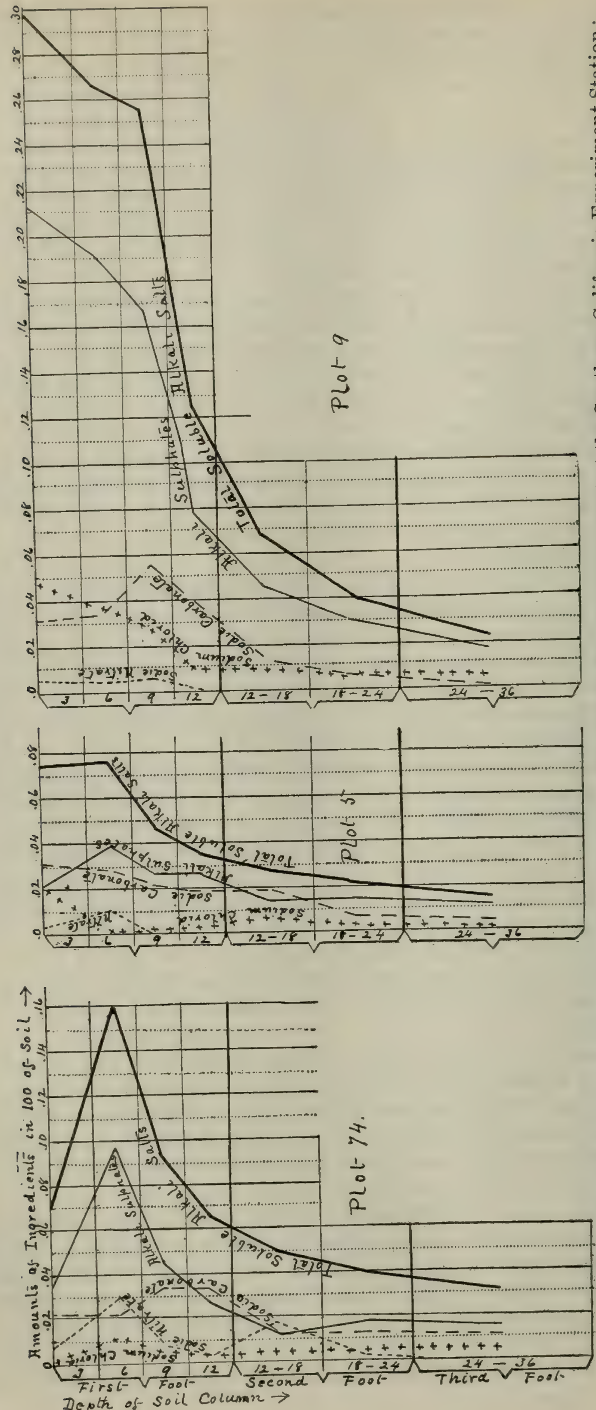
In plot No. 74 the largest amount (1,600 pounds per acre) is in the section of three to six inches, whence it rapidly diminishes in regular proportion to the bottom. The average for the entire twelve inches is .105 per cent, corresponding to 4,200 pounds per acre; that of the second foot, .046 per cent, or 1,820 pounds per acre; while in the third foot it diminishes to .032 per cent, or 1,280 pounds per acre — a very small amount. Then we find that, of the entire 7,300 pounds in the entire column, about 58 per cent is in the first foot.

The alkali sulphates comprise nearly 47 per cent of the total salts in the three-foot column of earth. The surface foot contains the greater portion of this.

The carbonate of soda is also greatest in the first foot—1,100 pounds out of a total 2,080 pounds per acre—reaching its maximum in the lower half of that foot. In the second foot the proportion of carbonate in the salts was the same as in the first foot, though the amount was less; but in the third foot the percentage in the salts increased to 34 per cent, in accordance with observations made at Tulare.

The nitrates, being dependent for their formation on access of air, are naturally chiefly found in the upper six inches of the soil, though there was a rather surprising accumulation in the upper part of the second foot. Similar instances have been found in the Tulare soils; all due, doubtless, to the leaching influence of the rainfall of the previous winter and spring.

Plot No. 9 is rich in alkali salts—the entire three feet containing



Amounts and Composition of Alkali Salts at various depths and points in the Ten-Acre Tract at the Southern California Experiment Station; taken last week in April, 1895.

LEACHINGS OF SOILS FROM THE TEN-ACRE BEET-TRACT OF THE SOUTHERN CALIFORNIA EXPERIMENT STATION. (Samples taken April, 1895.)

Plot No. 5.

Depths at which Samples were Taken.	In 100 Parts of Soil.					In 100 Parts of Salts.				Total Amount of Salts per Acre.				
	Total Soluble Salts.	Alkali Sulphates	Sodium Carbonate	Sodium Chlorid	Magnesium Nitrate	Alkali Sulphates	Sodium Carbonate	Sodium Chlorid	Magnesium Nitrate	Total Soluble Salts.	Sulphates	Carbonate	Chlorid	Nitrate
										lbs.	lbs.	lbs.	lbs.	lbs.
0 to 3 inches	.075	.026	.030	.014	.005	34.6	40.0	20.0	5.4	750	260	300	140	50
3 to 6 inches	.076	.038	.028	--------	.010	50.0	36.8	--------	13.2	760	380	280	--------	100
6 to 9 inches	.047	.026	.021	--------	--------	55.3	44.7	--------	--------	470	260	210	--------	--------
9 to 12 inches	.036	.026	.008	.002	--------	72.2	22.2	5.6	--------	360	260	80	20	--------
Average for first foot	**.059**	**.029**	**.022**	**.004**	**.004**	**53.0**	**35.9**	**6.4**	**4.7**	**2,340**	**1,160**	**870**	**160**	**150**
12 to 18 inches	.028	.014	.008	.006	--------	50.0	28.6	21.4	--------	560	280	160	120	--------
18 to 24 inches	.022	.014	.006	.002	--------	63.6	27.2	9.2	--------	440	280	120	40	--------
Average for second foot	**.025**	**.014**	**.007**	**.004**	--------	**56.8**	**27.9**	**15.3**	--------	**1,000**	**560**	**280**	**160**	--------
Average for third foot	**.015**	**.011**	**.004**	--------	--------	**73.3**	**26.7**	--------	--------	**600**	**440**	**160**	--------	--------
Average for three feet	**.033**	**.018**	**.011**	**.003**	**.001**	**61.0**	**30.2**	**7.2**	**1.6**	**3,940**	**2,160**	**1,310**	**320**	**150**
Plot No. 9.														
0 to 3 inches	.287	.206	.032	.044	.005	71.7	11.1	16.1	1.2	2,870	2,060	320	440	50
3 to 6 inches	.266	.191	.034	.037	.004	71.8	12.7	13.9	1.6	2,660	1,910	340	370	40
6 to 9 inches	.255	.167	.055	.028	.005	65.5	21.5	10.9	2.0	2,550	1,670	550	280	50
9 to 12 inches	.126	.079	.038	.009	--------	62.7	20.1	17.2	--------	1,260	790	380	90	--------
Average for first foot	**.234**	**.161**	**.040**	**.030**	**.003**	**67.9**	**16.3**	**14.5**	**1.3**	**9,340**	**6,430**	**1,590**	**1,180**	**140**
12 to 18 inches	.068	.046	.013	.009	--------	67.6	19.1	13.3	--------	1,360	920	260	180	--------
18 to 24 inches	.041	.030	.006	.005	--------	73.1	14.6	12.3	--------	820	600	120	100	--------
Average for second foot	**.055**	**.038**	**.010**	**.007**	--------	**70.4**	**16.8**	**12.8**	--------	**2,180**	**1,520**	**380**	**280**	--------
Average for third foot	**.022**	**.017**	--------	**.005**	--------	**77.3**	--------	**22.7**	--------	**880**	**680**	--------	**20**	--------
Average for three feet	**.104**	**.072**	**.017**	**.014**	**.001**	**72.4**	**11.0**	**16.3**	**.3**	**12,400**	**8,630**	**1,970**	**1,480**	**140**
Plot No. 74.														
0 to 3 inches	.098	.057	.021	.005	.015	59.1	21.4	4.2	15.3	980	570	210	50	150
3 to 6 inches	.160	.097	.021	.012	.030	60.6	13.1	7.6	18.7	1,600	970	210	120	300
6 to 9 inches	.094	.046	.034	.005	.009	48.9	36.1	5.3	9.7	940	460	340	50	90
9 to 12 inches	.068	.028	.034	.003	.003	41.2	50.0	4.4	4.4	680	280	340	30	30
Average for first foot	**.105**	**.057**	**.028**	**.006**	**.014**	**52.5**	**30.1**	**5.4**	**12.0**	**4,200**	**2,280**	**1,100**	**250**	**570**
12 to 18 inches	.051	.014	.014	.005	.018	27.4	27.4	35.3	9.9	1,020	280	280	100	360
18 to 24 inches	.040	.019	.013	.005	.003	47.5	32.5	12.5	7.5	800	380	260	100	60
Average for second foot	**.046**	**.017**	**.014**	**.005**	**.010**	**37.5**	**30.0**	**23.9**	**8.6**	**1,820**	**660**	**540**	**200**	**420**
Average for third foot	**.032**	**.016**	**.011**	**.005**	--------	**50.0**	**34.4**	**15.6**	--------	**1,280**	**640**	**440**	**200**	--------
Average for three feet	**.061**	**.030**	**.018**	**.005**	**.008**	**46.7**	**31.5**	**15.0**	**6.8**	**7,300**	**3,580**	**2,080**	**650**	**970**

12,400 pounds per acre—corresponding to one tenth of one per cent of the soil. Two thirds of this is in the first foot, and quite evenly distributed in the upper nine inches. Even this large amount does not equal that of some of the other plots examined in the ten-acre tract.

The alkali sulphates, of course, largely predominate, averaging from 63 to 77 per cent of the salts present; being again highest near the surface—2,000 pounds per acre.

Carbonate of soda comprises but 11 per cent of the whole, and is confined to the upper two feet, its maximum being at the bottom of the first foot. The third foot had only traces present when examined.

The chlorid, or common salt, bears about the same relation to the total salts as in the other sections.

The nitrate, or saltpeter, is quite small—far less than the average of the ten-acre tract at large. The cause is not immediately apparent, for when the foot samples of the tract were taken, that from this plot was highest of all in nitrates, with its 5,000 pounds per acre; there was only 140 pounds, when the three-foot series was taken in the spring. Probably the winter rains had leached out the greater part of the nitrates.

Plot No. 5 is quite low in total salts per acre (3,940 pounds), and the greater part of this is in the upper foot, and especially the first six inches of that foot.

The alkali sulphate, while highest in its soil percentage in the 3 to 6-inch section, falls behind the carbonate at the surface, and is but little above it in total percentage of the first foot. For the entire three feet it comprises but 61 per cent of the total salts, as against 30 per cent for the carbonate. The total amounts per acre, however, for both of these are comparatively small, and chiefly confined to the first twelve inches.

The nitrates are again smaller than the average of the entire tract, and even of a sample of the same lot taken the previous summer; the difference being doubtless due, as remarked above, to loss by leaching of the winter rains.

ANALYSES OF SUGAR BEETS GROWN ON ALKALI SOIL.

(From the ten-acre tract of the Experiment Station.)

The seed of several distinct varieties of sugar beets was planted at different times in 1894 on the eastern half of a few plots lying on the extreme eastern edge of the tract, the Vilmorin being on the outside. The Vilmorin Improved occupied the most westerly position in these plots, and adjoining some parallel rows of wheat, barley, and other small grain, which threw upon it their shade, and restrained the growth of the beets and materially increased the percentage of sugar.

In the following table the analyses of the beets were made by the chemist of the Chino factory, and kindly furnished to the Station. They are arranged according to the plots on which they were grown, the samples of each variety being placed according to time of planting; a general average of each variety also being given:

ANALYSES OF BEETS—PLOT 1.

Variety.	Planted.	Harvested.	Days in Ground.	Weight, in Ounces.	Sugar Percentage.	Purity Coefficient.
Vilmorin Improved	Feb. 26	July 19	146	14.0	16.2	83
	Feb. 26	July 19	146	15.5	13.8	82
	Feb. 26	Aug. 20	178	20.0	13.2	86
	Mar. 5	July 19	136	19.0	16.2	84
	Mar. 5	Aug. 3	151	9.8	15.6	87
	Mar. 5	Aug. 20	168	10.0	10.6	81
	Mar. 12	Sept. 1	172	12.0	10.5	74
Average				**14.2**	**13.7**	**84**
Mammalian Red	Feb. 26	July 19	146	**11.0**	**13.2**	**84**
Vilmorin	Feb. 26	July 19	146	14.0	16.2	83
	Feb. 26	July 19	146	15.5	13.8	82
	Feb. 26	Aug. 20	178	16.0	13.4	85
	Mar. 5	Aug. 20	168	33.0	10.0	73
	Mar. 12	Sept. 1	172	44.0	10.5	75
Average				**24.5**	**12.8**	**77**
Giant Golden	Feb. 26	July 19	146	**21.0**	**12.4**	**83**
White French	Feb. 26	July 19	146	**28.0**	**12.2**	**82**
C. R.	Feb. 26	July 19	146	29.0	10.7	74
	Mar. 5	Aug. 3	151	13.0	14.6	80
	Mar. 12	Aug. 3	144	14.0	15.8	
	Feb. 26	Oct. 5	224	15.0	9.1	70
	Mar. 12	Oct. 5	207	12.2	9.1	75
Average				**17.9**	**11.5**	**78**
Feed Beet	Feb. 26	July 19	146	**21.5**	**11.0**	**82**
L. R.	Mar. 5	Aug. 3	151	10.5	11.7	86
	Mar. 12	Sept. 1	172	17.0	8.6	70
	Feb. 26	Aug. 20	178	16.0	11.1	82
	Mar. 5	Aug. 20	168	19.0	8.7	77
Average				**15.6**	**10.0**	**79**
Norton's Giant	Feb. 26	July 19	146	**41.0**	**9.0**	**75**

ANALYSES OF BEETS—PLOT 26.

Vilmorin Improved	Mar. 19	Sept. 1	165	10.0	8.6	71
	Mar. 19	Aug. 9	143	13.0	12.9	88
	Mar. 26	Aug. 9	136	12.5	13.3	83
	Apr. 2	Aug. 9	129	10.2	13.9	89
	Apr. 2	Sept. 8	159	10.0	13.8	84
Average				**11.1**	**12.5**	**83**
L. R.	Mar. 19	Sept. 1	165	18.0	9.1	75
	Mar. 19	Aug. 9	143	10.8	11.8	82
	Mar. 26	Aug. 9	136	18.8	13.9	83
	Apr. 2	Aug. 9	129	14.5	13.8	89
	Apr. 2	Sept. 8	159	19.0	12.2	85
Average				**16.2**	**12.1**	**83**
Vilmorin	Mar. 19	Sept. 1	165	19.0	13.6	82
	Mar. 19	Aug. 9	143	33.8	11.9	80
	Mar. 26	Aug. 9	136	32.2	9.4	79
	Apr. 2	Aug. 9	129	25.5	11.0	76
	Apr. 2	Sept. 8	159	40.0	9.7	75
Average				**30.1**	**11.1**	**78**
C. R.	Mar. 19	Oct. 5	200	12.0	9.5	75
	Mar. 26	Oct. 5	193	31.0	10.5	77
	Apr. 2	Oct. 5	186	24.0	8.5	73
	Mar. 19	Aug. 9	143	16.2	11.4	80
	Mar. 26	Aug. 9	136	16.0	11.5	80
	Apr. 2	Aug. 9	129	17.2	12.8	83
	Mar. 19	Sept. 1	165	16.0	11.3	79
Average				**18.9**	**10.8**	**78**

ANALYSES OF BEETS—PLOT 27.

Variety.	Planted.	Harvested.	Days in Ground.	Weight, in Ounces.	Sugar Percentage.	Purity Coefficient.
L. R.	Apr. 9	Sept. 16	160	16.0	13.5	87
	Apr. 16	Sept. 16	153	22.0	12.7	83
	Apr. 23	Sept. 11	141	9.0	14.3	85
Average				**15.7**	**13.5**	**85**
Vilmorin Improved	Apr. 9	Sept. 8	152	12.0	12.0	80
	Apr. 16	Sept. 8	145	16.0	13.1	84
	Apr. 23	Sept. 11	141	7.0	13.3	83
Average				**11.7**	**12.8**	**82**
C. R.	Apr. 9	Oct. 5	179	21.1	11.1	79
	Apr. 16	Oct. 5	172	25.0	12.2	77
	Apr. 23	Oct. 5	165	15.0	12.4	81
	Apr. 23	Sept. 11	141	17.0	10.7	75
Average				**19.5**	**11.6**	**78**
Vilmorin	Apr. 9	Sept. 8	152	29.0	11.3	83
	Apr. 16	Sept. 8	145	33.0	11.3	79
	Apr. 23	Sept. 11	141	28.0	10.7	75
Average				**30.0**	**11.1**	**79**

ANALYSES OF BEETS—PLOT 52.

Vilmorin Improved	Apr. 30	Sept. 11	134	8.0	14.5	83
	May 7	Sept. 11	127	6.0	13.5	83
	May 14	Sept. 20	129	6.0	13.5	83
Average				**6.7**	**13.8**	**83**
L. R.	Apr. 30	Sept. 11	134	12.0	14.4	85
	May 7	Sept. 11	127	9.0	14.2	85
	May 14	Sept. 20	129	8.0	12.9	82
Average				**9.7**	**13.8**	**84**
Vilmorin	Apr. 30	Sept. 11	134	32.0	11.0	75
	May 7	Sept. 11	127	7.0	13.3	83
	May 14	Sept. 20	129	20.0	11.9	80
Average				**19.7**	**12.1**	**80**
C. R.	Apr. 30	Oct. 5	134	16.0	11.9	80
	May 7	Oct. 5	151	18.0	11.6	80
	May 14	Oct. 5	144	16.0	11.5	80
Average				**16.7**	**11.7**	**80**

ANALYSES OF BEETS—PLOT 53.

Vilmorin Improved	May 21	Sept. 20	122	**8.0**	**14.5**	**83**
L. R.	Feb. 26	July 19	146	16.0	14.0	81
	May 21	Sept. 2	111	7.0	13.3	85
Average				**12.5**	**13.5**	**83**
C. R.	May 21	Oct. 5	137	14.0	11.4	80
	May 28	Oct. 5	130	12.0	13.0	85
	May 21	Sept. 20	122	20.0	11.6	81
Average				**15.3**	**12.0**	**82**
Vilmorin	May 21	Sept. 20	122	**19.0**	**11.5**	**77**

ANALYSES OF BEETS—PLOT 78.

C. R.	June 11	Oct. 5	116	14.0	11.2	80
	June 11	Oct. 5	116	11.0	10.5	75
Average				**12.5**	**10.9**	**78**

ANALYSES OF FIELD BEETS.

(Taken indiscriminately from many plots.)

Variety.	Planted.	Harvested.	Days in Ground.	Weight, in Ounces.	Sugar Percentage.	Purity Coefficient.
O. D.	May 29	Oct. 5	129	13.0	14.5	87
	May 29	Sept. 1	94	15.0	12.3	85
	May 29	Sept. 1	94	10.0	13.7	81
	May 29	Sept. 20	112	19.0	13.9	82
	May 29	Sept. 20	112	12.0	14.3	83
	May 29	Sept. 29	123	16.0	14.3	87
	May 31	Sept. 29	121	17.0	14.3	86
	May 29	Sept. 29	123	21.0	13.6	86
Average				**15.4**	**13.8**	**85**

A general review of the above tables show that the Vilmorin Improved and the Vilmorin stand highest in sugar-percentage, with a maximum of 16.2 for the former. The variety designated C. R. comes next, with 15.8 per cent. These were all grown on plot No. 1, whose soil contains a very small amount of nitrate, but much carbonate of soda. All of the other varieties fell below 15 per cent.

The purity-coefficient was highest (89) in the Vilmorin Improved and the L. R., and in eleven samples of these the purity was 85 and above. In all other samples and varieties the purity was below 85 per cent, while twenty-four fell below 80 per cent.

Effect of Alkali.—In order to consider the effect produced on the beets by the alkali salts in the soil, a sample of the latter twelve inches deep was taken from each of the plots and analyzed, as already reported above.

In the following table the averages of the several varieties for each plot are grouped separately, and the analysis of the alkali salts of the plot placed in another column opposite. In this way we are better able to draw any conclusions as to the effect of the alkali than from the large general table given above. The list includes only such varieties as have been planted on two or more plots, for a single-plot test would yield no definite results, because of the varying characteristics in the beet varieties themselves; only the same variety upon different soils could give comparable results:

SUGAR BEETS GROUPED ACCORDING TO VARIETIES, IN ORDER OF SUGAR PER CENT.

Vilmorin Improved. (Next to grain rows.)

Plot.	Weight, in Ounces	Sugar	Purity	Total Soluble Salts.	Sulphate	Carbonate	Chlorid	Nitrate
53	8.0	14.5	83	.271	.179	.052	.038	.004
52	6.7	13.8	83	.093	.014	.053	.012	.014
1	14.2	13.7	84	.113	.033	.076	.002	.002
27	11.7	12.8	82	.157	.093	.042	.015	.007
26	11.1	12.5	83	.107	.059	.032	.009	.007

Vilmorin. (Outside row of tract.)

Plot.	Weight, in Ounces	Sugar	Purity	Total Soluble Salts.	Sulphate	Carbonate	Chlorid	Nitrate
1	24.5	12.8	77	.113	.033	.076	.002	.002
52	19.7	12.1	80	.093	.014	.053	.012	.014
53	19.0	11.5	77	.271	.179	.052	.038	.004
26	30.1	11.1	78	.107	.059	.032	.009	.007
27	30.0	11.1	79	.157	.093	.042	.015	.007

C. R.

Plot.	Weight, in Ounces	Sugar	Purity	Total Soluble Salts.	Sulphate	Carbonate	Chlorid	Nitrate
53	15.3	12.0	82	.271	.179	.052	.038	.004
52	16.7	11.8	80	.093	.014	.053	.012	.014
27	19.5	11.6	78	.157	.093	.042	.015	.007
1	17.9	11.5	78	.113	.033	.076	.002	.002
78	12.5	10.9	78	.140	.096	.016	.012	.016
26	18.9	10.8	78	.107	.059	.032	.009	.007

L. R.

Plot.	Weight, in Ounces	Sugar	Purity	Total Soluble Salts.	Sulphate	Carbonate	Chlorid	Nitrate
52	9.7	13.8	84	.093	.014	.053	.012	.014
53	12.5	13.5	83	.271	.179	.052	.038	.004
27	15.7	13.5	85	.157	.093	.042	.015	.007
26	16.2	12.1	83	.107	.059	.032	.009	.007
1	15.6	10.0	79	.113	.033	.078	.002	.002

The average of the Vilmorin Improved for all the lots was good, in both sugar and purity-coefficient. The sugar average was greatest on plot 53, which had the greatest total alkali salts (.271 per cent, or five tons per acre), the highest sulphate, and the highest chlorid (common salt). The sugar was lowest, from the soil having lowest carbonate of soda.

As already stated, however, in the single sample the sugar was highest (16.2 per cent) on plot 1, whose nitrate and chlorid were both very low, and whose total salts amounted to a little more than two tons per acre. The beets were comparatively small—three fourths of a pound average on plots 53 and 52, which gave the highest sugar averages—due, doubtless, to the influence of the adjoining grain rows.

The Vilmorin beets which occupied the outside row in these plots were much larger in size, and contained far less sugar than the Vilmorin Improved. The average weight on plot 1, which had the highest sugar, was two pounds.

In this case the soil with highest alkali (No. 53, with nearly five tons per acre) gave beets with very poor sugar. The lowest chlorids gave the best sugar, while the highest chlorids gave low sugar. These results were quite contrary to those from the Vilmorin Improved; and whether due to the large size attained by the roots, or to varietal difference, cannot be stated with certainty.

The beets of the L. R. variety were of good size on an average, and all but one group (from plot No. 1) fair in sugar-percentage and purity. In this case the best beets were from plot 52, containing the least alkali salts, though high in nitrates and carbonate of soda. Plot 53, which contained the greatest amount of alkali salts, as well as of chlorids, gave beets nearly as good as those from the least alkali.

The beets of the variety designated C. R. were, with only one exception, below 12 per cent in average of sugar, and all were above one pound in weight. The purity-coefficient was also low. The best beets came from the plot (No. 53) having the highest alkali salts, and which was high in chlorid and sulphate. This corresponds to the results from the Vilmorin Improved.

To test still further the effect of alkali salts, beets were taken for analysis from plots supposed, from surface appearances, to contain the greatest and least amount, respectively, of salts. It happens, however, that they have both since then been found to rank high in alkali salts, though not as high as the so-called niter plot described above. The beets were analyzed at this Station, with the following results:

ANALYSES OF SUGAR BEETS FROM SPECIAL PLOTS. By M. E. Jaffa.

	Analysis of Beets.			Analysis of Soils. (Parts in 100 of Soil.)				
	Weight	Sugar Percentage	Purity Coefficient	Total Alkali Salts	Alkali Sulphate	Sodium Carbonate	Sodium Chlorid	Magnesia Nitrate
	ozs.							
From Plot 158	17.4	16.3	93	.186	.069	.053	.033	.031
From Plot 24	20.2	15.9	92	.200	.136	.037	.004	.023
From Plot 8	38.9	10.1	67	.233	.059	.084	.082	.008
Special	------	------	------	.043	.018	.011	------	.014

The variety of seed planted on these plots is not known, but presumably the same for all, and hence the results may be comparable.

It is very clear that the beets were not affected seriously by the large amount of total salts (equivalent to four tons per acre) in plot 24, nor in plot 158, with its three and one half tons per acre; and we may conclude that that amount at least does not injure the crop. Similarly, we found in a previous paragraph that the Vilmorin Improved and L. R. did well on plot 52, with its five tons of total salts per acre. We do find, however, that on plot 8, which has much less of total salts than plot 52, the beets are large and very low in sugar. It is, therefore, conclusive that in this case the character of the salts must have something to do with low sugar-percentage.

The sulphates are much lower in No. 8 than in several of the soils which yield good beets. The nitrate of magnesia is also much lower in No. 8 than in plots yielding good beets. The carbonate and chlorid of sodium are each very much higher than in any alkali soil in which the beets did well, and it is thus possible that here we have indicated their respective limits (3,200 pounds each) for profitable beet culture. But this will have to be further tested.

An analysis was made of the alkali salts of a soil from the Rincon Ranch, seven or eight miles from Chino, the beets from which yielded, according to the Chino factory chemist, 19 to 21 per cent of sugar as an average of several loads. The soil is a reddish clay, holding about 1,700 pounds of alkali salts per acre. The only material difference between this and the soils of the beet-plots of the ten-acre tract just described, is in the chlorid of sodium, which is present only in traces. There is nothing else to indicate the cause of so high a percentage of sugar.

General Summary of Results.—The data and observations recorded above, while still requiring confirmation in regard to details, prove beyond question that sugar beets of good, and even high grade, both as to sugar and purity, may be grown on lands containing as much as 12,000 pounds of alkali salts per acre to the depth of three feet; provided, that the percentage of common salt in the soil does not exceed an average of .04 per cent, or 1,500 pounds, per acre. Even this may not, of course, represent the maximum compatible with good quality, but is the highest figure that has yielded such, viz., good quality, in the course of our experiments thus far.

As regards the *carbonate*, inasmuch as it is easily convertible into sulphate by means of gypsum, the figure for its maximum tolerance is not of first importance; but so far as our experiments go, it seems to lie near .076 per cent, or 3,000 pounds, per acre for the first foot—implying probably about 4,000 pounds for the first three or four feet. Within the limits of our experience at Chino the carbonates do not appear to be more injurious to the quality of the roots than the sulphates, and not near as much as the chlorids (common salt).

As regards the *sulphates*, the maximum amount found to be present at any point where good beets were obtained was .179 per cent of the soil, or 7,200 pounds per acre in the first foot—implying, for the total depth of three feet, about one fourth more, or a total of 9,000 pounds per acre.

If these figures can be assumed to represent the upper limits of tolerance of these salts for sugar-beet culture (and comparison with results from plot 8, and others, seems to render this likely), it becomes easily intelligible that at the Tulare Station, where the average content of alkali salts in the soil is considerably higher, and where common salt usually forms about one third of the total, no beets of good quality have thus far been obtained. From the compact nature of their soil, the Chino lands, when put under cultivation, make a show of alkali efflorescences quite out of proportion to the really small contents of their salts; while, on the other hand, loose sandy soils elsewhere, though showing but a slight surface efflorescence, may fall beyond the limits of tolerance. It is quite probable, of course, that these limits vary somewhat for soils of different textures.

It will be seen, by reference to the discussion of the experiments at Tulare, that the minimum amounts of alkali salts found there were from 12,000 to 15,000 pounds per acre in the first four feet, which is above the maximum thus far examined at Chino. Thus the term "semi-alkaline," applied to the lower lands of the Chino Ranch by Mr. Gird, appears amply justified, since the average total of salts, as ascertained at the Station ten-acre tract, is 5,500 pounds per acre to the depth of one foot; and, if taken to the depth of three feet, would probably not exceed 7,500 pounds per acre.

These results emphasize the importance of ascertaining the total of salts present in the soil stratum of three to four feet, which may ultimately rise to the surface under cultivation or irrigation; and this is the more important because, as the present example shows, the texture of the soil may cause so great a difference in the appearance of the surface efflorescences, that lands perfectly capable of being profitably cultivated may, to the eye, be too heavily impregnated for that purpose. The test heretofore recommended by taking the average of the first four feet of the soil stratum, by means of a post-hole auger, and determining the total amount of salts contained in it, thus commends itself most strongly to all interested in alkali lands.

III. ANALYSES OF WATERS.

Several years ago it was thought desirable to obtain, by analyses from different places, a general idea of the composition of the waters of California. This work has yielded data of considerable interest, and has resulted in acquiring a fairly accurate knowledge of the characters of the waters to be expected in various portions of the State. The demand for such work has, however, outgrown altogether the amount of time that can justly be given to work that is often of merely private interest, and it is intended that hereafter such work shall be confined to waters intended to be used for irrigation, and to such as are of wider interest in newly settled regions. Sanitary analyses of the water-supply of towns can only in exceptional cases be considered proper part of the public work contemplated.

The analyses given below were made chiefly by Messrs. Loughridge and Jaffa; a few by Messrs. Tompkins, Swingle, and Rogers, students in the Agricultural laboratory.

Several samples of water received from private parties were too small for determinations of any value, and are not reported.

A. STREAM AND LAKE WATERS.

Waters from Hollister, San Benito County; sent by N. C. Briggs. No. 1 is from Dos Picachos Creek, 7 miles east of Hollister; Nos. 2 and 3 are from the Hollister waterworks, received at different times.

	Dos Picachos.		Waterworks.			
	No. 1.		No. 2.		No. 3.	
	Grains per Gallon.	Parts in 10,000.	Grains per Gallon.	Parts in 10,000.	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	14.81	2.53	41.99	7.19	15.18	2.60
Soluble in water after evaporation	4.68	.81	23.42	4.01	2.33	.41
Insoluble in water after evaporation	9.66	1.64	12.73	2.18	10.34	1.76
Organic matter and chemically combined water	.47	.08	5.84	1.00	2.51	.43
The soluble part consists of—						
Sodium and potassium sulphates (Glauber's salt, etc.)	--------	--------	16.92	2.90	.94	.19
Sodium chlorid (common salt)	--------	--------	6.04	1.03	1.17	.20
Sodium carbonate (sal soda)	--------	--------	.46	.08	.22	.02
The insoluble part consists of—						
Calcium and magnesium carbonates	--------	--------	9.92	1.70	4.45	.76
Silica	5.20	.89	2.81	.48	5.89	1.01

Sanitary Analysis.

	Grains per Gallon.		Parts per Million.		
	Total Residue.	Chlorine.	Free Ammonia.	Albuminoid Ammonia.	Oxygen Consumed.
No. 1. From Picachos Creek	14.81	.69*	Trace.	.042	1.20
No. 2. From Waterworks	41.99	3.68†	Trace.	.036	.80

*Equivalent to 1.13 grains common salt per gallon.
†Equivalent to 6.04 grains common salt per gallon.

The three samples differ widely, both in total contents and in the nature of the salts. The waters of the Dos Picachos Creek and of the waterworks No. 3 come fully within the limit of good potable waters, although quite "hard" enough to incrust tea-kettles and to curdle soap almost as badly as that of No. 2. But the saline ingredients are no more than is contained in most potable waters of this State.

The water No. 2 of the waterworks exceeds by two grains, in total mineral ingredients, the limits usually assigned to potable water. The amount of soluble salts is so great and their nature such that it cannot fail to affect injuriously the health of many persons.

There are no signs of organic contamination in any of the waters.

Water from Salinas River at Paso Robles, San Luis Obispo County. The sample was taken by R. H. Loughridge, from the stream, 200 yards above the bridge, August 15, 1895. It was clear, but with floating moss:

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	32.71	5.60
Soluble in water after evaporation	13.43	2.30
Insoluble in water after evaporation	10.52	1.80
Organic matter and chemically combined water	8.76	1.50
The soluble part consists of—		
Sodium and potassium sulphates (Glauber's salt, etc.)	8.25	1.42
Sodium chlorid (common salt)	2.71	.46
Sodium carbonate (sal soda)	2.47	.42
The insoluble part consists of—		
Calcium and magnesium carbonates	8.52	1.46
Calcium sulphate (gypsum)		
Silica	2.00	.34

Waters of mountain streams; sent by the Hollister Water Company; T. W. Hawkins. No. 1; taken 300 yards from a spring near top of mountain range. No. 2; taken 800 feet below No. 1, and two miles from its source; not the same. No. 3; seven miles from its source; flows through decomposed granite.

	No. 1.		No. 2.		No. 3.	
	Grains per Gallon.	Parts in 10,000.	Grains per Gallon.	Parts in 10,000.	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	20.15	3.45	22.19	3.80	10.81	1.85
Soluble in water after evaporation	2.10	.36	3.79	.65	3.79	.65
Insoluble in water after evaporation	13.26	2.27	10.81	1.85	6.14	1.05
Organic matter and chemically combined water	4.79	.82	7.59	1.30	.88	.15
The soluble part consists of—						
Sodium and potassium sulphates (Glauber's salt, etc.)	.62	.02	1.07	.19	3.05	.43
Sodium chlorid (common salt), chiefly						
Sodium carbonate (sal soda)	1.48	.34	2.72	.46	.74	.12
The insoluble part consists of—						
Calcium carbonate, chiefly	12.26	2.10	9.93	1.70	4.32	.75
Calcium sulphate (gypsum)						
Silica	1.00	.17	.88	.15	1.82	.30

The above waters are good for all domestic purposes, though the first two are quite "hard" from the presence of lime carbonate, which can easily be removed by the usual methods. No. 3 is an unusually fine water; soft, and in every way as good as could be desired.

Water from Soledad Slough, Monterey County; sent by H. H. Tracy, of San Francisco. "The slough, or old channel of Salinas River, is one half mile below the mouth of 'Arroyo Seco,' and on the same side of the river as that stream. The sample sent is probably mainly water from the Arroyo Seco."

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	27.1	4.15
Soluble in water after evaporation	12.8	1.69
Insoluble in water after evaporation	12.9	2.21
Organic matter and chemically combined water	1.4	.25
The soluble part consists of—		
Sodium sulphate (Glauber's salt)	3.4	.58
Potassium sulphate	3.3	.06
Magnesium sulphate (Epsom salt)	3.8	.65
Sodium chlorid (common salt)	2.3	.40
The insoluble part consists of—		
Calcium carbonate	7.6	1.30
Magnesium carbonate	1.9	.32
Calcium sulphate (gypsum)	1.6	.28
Silica	1.8	.31

The water is almost identical in composition with that of a well on the Mission Ranch, one half mile distant. The content is surprisingly small for the region from which the water comes; and, while somewhat "hard," it is suitable for all uses, irrigation or domestic.

Water from a lake 1,500 feet above the sea, 2½ miles south of Creston, San Luis Obispo County; sent by J. G. W. Schulte, of San Francisco. The lake is said to cover about 17 acres; its water has a greenish tint when fresh. The sample brought had been bottled six months previously, and a heavy sediment of silica, with some iron oxid, had formed, and the water had become yellowish from organic matter, and slightly alkaline in character. The water itself contains a trace of iron, and the green coloration when fresh is due doubtless to a small amount of ferric carbonate.

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	156.83	26.85
Soluble in water after evaporation	117.41	20.10
Insoluble in water after evaporation	4.69	.80
Organic matter and chemically combined water	34.73	5.95
The soluble part consists of—		
Sodium and potassium sulphates (Glauber's salt, etc.)	4.90	.85
Sodium chlorid (common salt)	69.17	11.83
Sodium carbonate (sal soda)	43.34	7.42
The insoluble part consists of—		
Calcium and magnesium carbonates	4.69	.80
Calcium sulphate (gypsum)		
Silica		

This is the composition of a good many "black alkali" seepage waters; an alkaline saline water of moderate strength and slightly chalybeate.

Water sent by Lewis Waggener, of Kingsburg, Fresno County. One of these samples was taken from a waste ditch containing the drainage water of this district. The other sample is from a pond, or "check," which has been covered for about a year, and in which there is quite a growth of vegetation. In the center and sides is an apparently succulent moss, which is eaten by stock, and on the edges of the pond are tules and flags.

	Ditch Water.		Pond Water.	
	Grains per Gallon.	Parts in 10,000.	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	17.21	2.95	26.27	4.50
Soluble in water after evaporation	6.42	1.10	6.42	1.10
Insoluble in water after evaporation	6.71	1.15	4.38	.75
Organic matter and chemically combined water	4.08	.70	15.47	2.65
The soluble part consists of—				
Sodium and potassium sulphates (Glauber's salt, etc.)	5.72	.97	3.31	.57
Sodium chlorid (common salt)				
Sodium carbonate (sal soda)	.70	.13	3.11	.53
The insoluble part consists of—				
Calcium and magnesium carbonates	4.55	.78	4.08	.70
Calcium sulphate (gypsum)				
Silica	2.16	.37	.30	.05

Apparently the two waters differ quite materially in their present composition—the pond water containing a very "black" alkali, while that of the ditch is "white." This change has been brought about by the vegetation in the pond, the water from which has apparently neither lost nor taken up any alkali from the soil. The large amount of vegetable matter in the pond water has been dissolved by the carbonate of soda.

There is nothing to prevent the use of the ditch water for irrigation purposes, for the mineral salty matter in it is no greater than naturally in many of our irrigation waters.

B. SPRING WATERS.

Sulphur waters from Wilbur Springs; sent by W. J. West, of Sulphur Creek P. O., Colusa County. The water of one of these springs has a temperature of 145°, while that of the other is cold. The analyses were made by P. W. Tompkins. Both waters contain sulphuretted hydrogen gas; and lithium and boracic acid are found in each.

	No. 1. Hot Spring.		No. 2. Cold Spring.	
	Grains per Gallon.	Parts in 10,000.	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	1,395.03	238.82	171.20	29.43
Soluble in water after evaporation	1,229.20	227.56	119.05	18.67
Insoluble in water after evaporation	15.01	2.56	35.28	6.04
Organic matter and chemically combined water	50.82	8.70	27.57	4.72
The soluble part consists of—				
Sodium and potassium sulphates (Glauber's salt, etc.)	83.72	14.68	10.82	1.27
Sodium chlorid (common salt)	958.89	163.80	94.52	16.66
Sodium carbonate (sal soda)	286.59	49.08	3.71	.64
The insoluble part consists of—				
Calcium and magnesium carbonates (No. 2, large) Calcium sulphate (gypsum); (equal No. 1; No. 2, small)	8.70	1.49	34.18	5.85
Silica	6.31	1.07	1.10	.19

The water of the hot spring is of an exceptionally strong saline alkaline character, which, with the sulphur contained in it, will doubtless render it efficient in many cases of disease; but it must be used with caution.

That of the cold spring, while containing Glauber's and common salt in about the same relative proportions, is very much weaker, and notably less alkaline. In addition to this, its high content of earths (calcium and magnesium carbonates) would render it suitable for a different range of cases from No. 1.

Water from a mountain spring on "Johannisberg" ranch, near Napa; sent by A. V. Stubenrauch. The analysis was made by P. W. Tompkins.

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	3.97	.68
Soluble in water after evaporation	.70	.12
Insoluble in water after evaporation	1.87	.32
Organic matter and chemically combined water	1.40	.24

This is a remarkably pure mountain water, such as seems to characterize a certain region on the west side of the Napa Valley.

Spring waters from "Asthmatics' Paradise," Atlas, Napa County; sent by A. H. Wilson.

	No. 1.		No. 2.		No. 3.	
	Grains per Gallon.	Parts in 10,000.	Grains per Gallon.	Parts in 10,000.	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	12.55	2.15	14.31	2.45	10.00	1.70
Soluble in water after evaporation	5.37	.92	2.92	.50	--------	--------
Insoluble in water after evaporation	6.71	1.15	7.30	1.25	7.00	1.20
Organic matter and chemically combined water	.47	.08	4.09	.70	3.00	.50
The soluble part consists of—						
Sodium and potassium sulphates (Glauber's salt, etc.)	5.37	.92	2.92	.50	trace.	--------
Sodium chlorid (common salt)						
Sodium carbonate (sal soda)						
The insoluble part consists of—						
Calcium and magnesium carbonates	.58	.10	1.75	.30	trace.	--------
Silica	6.13	1.05	5.55	.95	7.00	1.20

Sample No. 2 contains some sulphuretted hydrogen gas.

The above waters, in common with those of the county, have the peculiarity of a remarkably high content of silica; aside from this, their mineral content is very small, so that from that point of view they may be considered exceptionally pure.

Spring water from J. P. Whitaker, Santa Rosa, Sonoma County. Bubbles of gas constantly rise through the water; and when exposed to the sun and air, a yellow scum forms on the surface and on the sides.

The sample received was clear, colorless, and tasteless.

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	13.73	2.35
Soluble in water after evaporation	3.21	.55
Insoluble in water after evaporation	7.89	1.35
Organic matter and chemically combined water	2.63	.45
The soluble part consists of—		
Sodium and potassium sulphates (Glauber's salt, etc.), etc.	.84	.15
Sodium chlorid (common salt)	.82	.14
Sodium carbonate (sal soda)	1.55	.26
The insoluble part consists of—		
Calcium and magnesium carbonates, etc.	3.21	.55
Calcium sulphate (gypsum)		
Silica	4.68	.80

Oxygen consumed in moist combustion, 1.00 part per million.

This is a very good water for domestic use; rather purer than most of the waters of the region, except that it contains an unusual amount of silica, which probably makes the water turbid on standing for a while; but that is of no consequence.

Water from a spring one half mile from the Madrone Soda Spring; sent by O. D. Arnold, of Madrone, Santa Clara County. "The spring is in a tributary of Soda Spring Cañon, at an elevation of 1,700 feet, or 300 feet above the Madrone Springs."

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	77.57	13.29
Soluble in water after evaporation	8.12	1.40
Insoluble in water after evaporation	58.17	9.96
Organic matter and chemically combined water	11.28	1.93
The soluble part consists of—		
Sodium and potassium sulphates (Glauber's salt, etc.)	1.94	.35
Sodium chlorid (common salt)	.61	.10
Sodium carbonate (sal soda)	5.57	.95
The insoluble part consists of—		
Calcium carbonates	12.15	2.08
Magnesium carbonate	36.80	6.31
Calcium sulphate (gypsum)	.41	.07
Iron carbonate	2.50	.42
Silica	5.66	.97
Calcium phosphate	.65	.11

The above water contains too much mineral matter to make it suitable for ordinary purposes. It is a mineral water highly charged with magnesia and lime carbonates, and enough of iron carbonate to render it slightly chalybeate in character.

Spring water from the Dunne Ranch, San José; sent by Burbank & Devendorf:

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	231.54	39.65
Soluble in water after evaporation	186.03	31.85
Insoluble in water after evaporation	23.61	4.05
Organic matter and chemically combined water	21.90	3.75
The soluble part consists of—		
Sodium and potassium sulphates (Glauber's salt, etc.) Magnesium sulphate (Epsom salt)	140.03	23.96
Sodium chlorid (common salt)	46.00	7.89
Sodium carbonate (sal soda)	------------	------------
The insoluble part consists of—		
Calcium and magnesium carbonates Calcium sulphate (gypsum), chiefly	21.90	3.75
Silica	1.71	.30

The high content of mineral matter, and the character of the latter, make this water entirely unfit for domestic use; and almost equally so for irrigation purposes, as it would soon charge any soil with too much "white" alkali for the growth of any useful crop, unless the soil were so porous and the water used in such abundance as not to be materially concentrated by surface evaporation. Crops will grow with their roots moistened with such water as this, but they will not stand its being materially strengthened by evaporation.

Spring water from Los Gatos, Santa Clara County; samples sent by J. N. Adams, of Los Gatos Hotel:

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	20.97	3.59
Soluble in water after evaporation	6.48	1.11
Insoluble in water after evaporation	10.34	1.77
Organic matter and chemically combined water	4.14	.71
The soluble part consists of—		
Sodium and potassium sulphates (Glauber's salt, etc.)	.02	.00
Sodium chlorid (common salt)	.27	.05
Sodium carbonate (sal soda)	6.19	1.06
The insoluble part consists of—		
Calcium and magnesium carbonates, etc.	10.34	1.77
Calcium sulphate (gypsum), very little		
Silica	trace.	------------

This is a "hard" water, of ordinary composition and mineral content, and suitable for domestic use. It can be readily softened by boiling, or by a small dose of lime water; or, for washing, by means of borax or sal soda, if desired.

Spring water; sent by W. De Crow, of San José. The spring is located on a mountain side, at an elevation of 500 feet, or 175 feet above the valley. It has a flow of 180 gallons per hour. The altitude of the mountain is 1,400 feet.

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	23.36	4.00
Soluble in water after evaporation (chiefly alkali sulphates)	2.92	.50
Insoluble in water after evaporation (chiefly carbonate of lime)	16.35	2.80
Organic matter and chemically combined water	4.09	.70

This water is only "hard" from the presence of lime carbonate, which can be removed by boiling. It is suitable for both domestic and irrigation use.

Water from a spring at the foot of the Gabilan range of mountains, about 9 miles northeast of Salinas City, Monterey County; sent by J. H. Brousse, Salinas.

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	21.20	3.63
Organic matter and chemically combined water	4.56	.78
Soluble part (chiefly chlorid of sodium)	4.97	.85
Insoluble part (chiefly carbonate of lime)	8.17	1.40
Silica	3.50	.60

The mineral content of this water is of the usual kind and amount; except, perhaps, in that there is a rather large proportion of silica. It is rather "hard," but otherwise adapted to every ordinary use, whether domestic or irrigation.

Water from a spring, 6 miles from Montecito, Santa Barbara County; sent by A. H. Hastie, of San Francisco. "The spring is 17 miles from the west line of Ventura County; formation is limestone shale, with streaks of gypsum. The water, when standing in a pool, becomes coated with a thin sheet. It has a bitter and acrid taste, and leaves in the mouth a hot sensation soon after tasting." Analysis made by P. W. Tompkins.

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	1,674.78	286.71
Soluble in water after evaporation	1,512.58	258.95
Insoluble in water after evaporation	162.20	27.76
Organic matter and chemically combined water	----------	----------
The soluble part consists of—		
Potassium sulphate	11.34	1.94
Sodium sulphate (Glauber's salt)	475.61	81.42
Magnesium sulphate (Epsom salt)	546.28	93.53
Sodium chlorid (common salt)	196.26	33.60
Sodium carbonate (sal soda)	3.09	.53
Magnesium nitrate	280.00	47.93
The insoluble part consists of—		
Magnesium carbonate	7.70	1.31
Calcium phosphate	7.18	1.23
Calcium sulphate (gypsum)	137.01	23.46
Iron carbonate	9.18	1.57
Silica	1.13	.19

The above water compares very closely with that sent by E. H. Heacock (and given in the Experiment Station Report for 1890, page 61), except as to total strength, this being one fifth weaker in total ingredients. The chief differences are that the above water contains proportionally more sulphate of lime and soda, while the ratio between magnesia sulphate and nitrate is nearly the same in both.

Spring water; sent by V. Roberts, of Alcalde, Fresno County. "The spring flows from a blue-clay slate formation, pitching almost vertically to the north. The flow of water is about one inch, and rises upward like an artesian well, with here and there an escape of bubbles of gas."

The water was examined by G. K. Swingle, a student in the Agricultural laboratory, with the following result:

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	399.57	68.60
Soluble in water after evaporation	359.08	61.56
Insoluble in water after evaporation	22.19	3.84
Organic matter and chemically combined water	13.43	2.35
The soluble part consists of—		
Sodium and potassium sulphates (Glauber's salt, etc.)	18.31	3.36
Sodium chlorid (common salt)	327.36	55.90
Sodium carbonate (sal soda)	13.61	2.30
The insoluble part consists of—		
Calcium and magnesium carbonates	22.19	3.84
Calcium sulphate (gypsum)	4.67	2.35
Silica		

The water is merely a salt brine, such as is common in springs and streams in the alkali region. Were it strong enough, it would make very good material for salt-boiling. Of course it is unfit for irrigation or domestic uses.

Water from a spring adjoining the city limits, on the west side, of Santa Barbara. Sent by Walter S. Maxwell, of Los Angeles. The water has a deep yellow color, neutral reaction, and a highly disagreeable and bitter taste. Its composition is as follows:

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	1,810.45	309.95
Soluble in water after evaporation	1,499.50	256.71
Insoluble in water after evaporation	5.95	1.03
Organic matter and chemically combined water	305.00	52.21
The soluble part consists of—		
Sodium and potassium sulphates (Glauber's salt, etc.)	89.50	15.22
Magnesium sulphate	1,092.30	187.00
Sodium chlorid (common salt)	160.40	27.56
Sodium carbonate (sal soda)	8.35	1.43
Magnesium nitrate	148.95	25.50
The insoluble part consists of—		
Calcium and magnesium carbonates	----------	----------
Calcium sulphate (gypsum)	----------	----------
Silica	5.95	1.03

The water closely resembles that of the Veronica Springs, two miles from Santa Barbara, in its high mineral content and nitrates. It is of course a strong purgative, with the Glauber's salt and nitrates as sedatives.

Waters from the San Jacinto Relief Hot Mud Springs; sent by L. M. Millard, of San Jacinto, Riverside County.

	Spring No. 1.		Spring No. 5.	
	Grains per Gallon.	Parts in 10,000.	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	363.13	62.17	47.02	8.05
Soluble in water after evaporation	220.21	37.70	35.92	6.15
Insoluble in water after evaporation	134.11	21.25	7.59	1.30
Organic matter and chemically combined water	18.81	3.22	3.51	.60
The soluble part consists of—				
Sodium and potassium sulphates (Glauber's salt, etc.)	31.61	5.48	1.20	.20
Sodium chlorid (common salt)	185.50	31.69	34.00	5.85
Sodium carbonate (sal soda)	3.10	.53	.62	.10
The insoluble part consists of—				
Calcium and magnesium carbonates	122.94	21.05	5.84	1.00
Calcium sulphate (gypsum)				
Silica	1.17	.20	1.75	.30

Spring No. 5 has traces of boracic acid.

The two waters, while differing widely in the total amount of mineral ingredients present, agree in that the predominant ingredient in both is common salt; No. 1, however, contains a larger relative proportion of sodium sulphate (Glauber's salt), which, with the calcium sulphate, impart to it a more purgative character. The larger proportion of boracic acid in No. 5, on the other hand, renders it more efficacious than No. 1, in another direction.

Spring water from San Diego; sent by F. W. Bradley. The spring is on a mountain side, 35 miles from San Diego and 5 miles from Foster's Station, the terminus of the San Diego, Cuyamaca, and Eastern Railroad. The flow is about twenty-five barrels per twenty-four hours. The water is very pure, containing but 8 grains of mineral matter per gallon; this is composed of about 5 grains of chlorid of sodium (common salt), the rest is of carbonates of lime and magnesia.

Water from an irrigating ditch; used also for drinking purposes; sent by James Whitaker, of Orange. The analysis was made by P. W. Tompkins, student in the Agricultural laboratory. No nitrates were found.

	Grains per Gallon.	Parts in 10.000.
Total residue by evaporation	25.70	4.40
Soluble in water after evaporation	14.54	2.49
Insoluble in water after evaporation	7.59	1.20
Organic matter and chemically combined water	3.57	.61
The soluble part consists of—		
Sodium and potassium sulphates (Glauber's salt, etc.)	9.95	1.71
Sodium chlorid (common salt)	2.73	.46
Sodium carbonate (sal soda)	1.86	.32
The insoluble part consists of—		
Calcium and magnesium carbonates and calcium sulphate (gypsum); equal	6.89	1.18
Silica	.70	.12

Oxygen consumed by moist combustion, 2.00 parts per million.

The water is unobjectionable for domestic use, though it might possibly act a little as a purgative on some persons. It is no stronger in minerals than a good many of the well-waters of the Santa Clara Valley, and shows no sign of contamination of any kind from artificial sources.

C. COMMON WELL WATERS.

Water from a well in Cortinia Valley, 15 miles west of Arbuckle; sent by John McClure, of Arbuckle, Colusa County. The well has been bored to 200 feet in depth. Its composition was found to be as follows:

	Grains per Gallon.	Parts in 10.000.
Total residue by evaporation	259.34	44.40
Soluble in water after evaporation	196.25	33.40
Insoluble in water after evaporation	16.66	3.05
Organic matter and chemically combined water	46.43	7.95
The soluble part consists of—		
Sodium and potassium sulphates (Glauber's salt, etc.)	15.96	2.44
Sodium chlorid (common salt)	180.23	30.86
Sodium carbonate (sal soda)	.06	.10
The insoluble part consists of—		
Calcium and magnesium carbonates	15.48	2.65
Calcium sulphate (gypsum)		
Silica	1.18	.40

This is one of the "white alkali" waters so common in this State. It is unavailable for either domestic or irrigation use, except that, if abundantly used on a porous soil, it may answer for vegetables—the point being not to allow the salts to accumulate at the surface, and to wash them out, by abundant use, so soon as they begin to show on the surface. The water will not hurt most plants, unless concentrated by evaporation.

Well water, from a well 209 feet deep; sent by G. H. High, of Grimes' Landing, Colusa County. It is a "hard" water, with very little else than carbonates of lime and magnesia. It contains 22.7 grains per gallon.

Water from Guinda, Yolo County; from F. Swete. The analysis was made by R. R. Rogers, a student in the Agricultural laboratory.

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	31.71	5.43
Soluble in water after evaporation	18.45	3.15
Insoluble in water after evaporation	8.83	1.52
Organic matter and chemically combined water	4.43	.76
The soluble part consists of—		
Sodium and potassium sulphates (Glauber's salt, etc.), etc.	6.05	1.04
Sodium chlorid (common salt)	12.27	2.09
Sodium carbonate (sal soda)	.13	.02
The insoluble part consists of—		
Calcium and magnesium carbonates, etc.	8.11	1.39
Calcium sulphate (gypsum)		
Silica	.72	.13

While the amount of total salts in the water is rather high for drinking purposes, it happens that the greater part of these salts are not injurious to the system. Common salt and lime carbonate comprise two thirds of the residue. The water is very good for domestic uses.

Water from two wells at Davisville, Yolo County; sent by G. H. Swingle. Water from Well No. 1 is used for stock. Well No. 2 is 80 feet deep, and tubed the entire depth. Both waters have a slightly alkaline reaction. The residue of No. 1 blackened on heating; that of No. 2 did not. Analyses were made by G. K. Swingle, a student in the Agricultural laboratory.

	Well No. 1.		Well No. 2.	
	Grains per Gallon.	Parts in 10,000.	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	44.15	7.66	31.40	5.40
Soluble in water after evaporation	23.36	1.14	13.99	2.41
Insoluble in water after evaporation	13.10	2.29	12.16	2.09
Organic matter and chemically combined water	7.59	1.35	5.25	.90
The soluble part consists of—				
Sodium and potassium sulphates (Glauber's salt, etc.)	16.68	2.88	11.40	1.97
Sodium chlorid (common salt)	5.45	.93	1.36	.23
Sodium carbonate (sal soda)	1.23	.21	1.23	.21
The insoluble part consists of—				
Calcium and magnesium carbonates	9.02	1.58	10.16	1.74
Calcium sulphate (gypsum)				
Silica	4.08	.71	2.00	.35

Both of these waters are rather too high in mineral content for constant domestic use. Their "hardness" may be remedied, but the amount of Glauber's salt, etc., is excessive for safety. They may be used for irrigation.

Well water from Dos Palos, Merced County; sent by B. Marks.

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	161.21	27.60
Soluble in water after evaporation	121.26	20.76
Insoluble in water after evaporation	31.19	5.34
Organic matter and chemically combined water	8.76	1.50
The soluble part consists of—		
Sodium and potassium sulphates (Glauber's salt, etc.)	11.52	2.01
Sodium chlorid (common salt)	109.12	18.64
Sodium carbonate (sal soda)	.62	.11
The insoluble part consists of—		
Calcium and magnesium carbonates	8.58	1.47
Calcium sulphate (gypsum)	21.44	3.67
Silica	1.17	.20

This water, with its high content of mineral ingredients, and especially of common salt, is not suited to either domestic or irrigation uses in that region of the State.

Well water from land of Prof. A. R. Sprague, Solano Ranch, Hanford, Kings County; sent by Gilby A. Roberts. "The water was reached at about three feet below the surface of the land, which is of the blackest of alkali. Hardpan was struck at a depth of two feet, and several inches in thickness."

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	26.28	4.50
Soluble in water after evaporation	7.89	1.35
Insoluble in water after evaporation	13.43	2.30
Organic matter and chemically combined water	4.96	.85
The soluble part consists of—		
Sodium and potassium sulphates (Glauber's salt, etc.)	2.83	.49
Sodium chlorid (common salt)	1.35	.23
Sodium carbonate (sal soda)	3.71	.63
The insoluble part consists of—		
Calcium and magnesium carbonates	11.69	2.10
Calcium sulphate (gypsum)		
Silica	1.74	.20

This bottom water, while it does contain the ingredients of the "black" alkali at the surface, is not more strongly mineral than are a good many irrigation waters (especially artesian) now successfully used.

It is evident that the annual rainfall of the region does not carry the surface alkali down to the bottom water to any great extent. Nevertheless, land irrigated with it should have a few hundred pounds of gypsum per acre, from time to time, to offset the alkali introduced, and the same in heavy doses should evidently be used in the holes where trees are planted.

Well water from Hanford, Cal.; sent by Robert Musgrave, M.D. The water is clear, colorless, and odorless.

	Grains per Gallon.	Parts per Million.
Total solids	11.09	----------
Chlorine	.30	----------
Free ammonia	----------	.006
Albuminoid ammonia	----------	.046
Oxygen consumed in moist combustion	----------	1.700

This is a very pure water, and good for all domestic uses.

Waters from Bethany, San Joaquin County; sent by Wm. B. Faulkner.

No. 1. From a dug well, 150 feet deep, in valley land, about 3 miles southwest of Bethany. It will destroy the best tin tea-kettle in from three to four weeks, and leaves on the inside of galvanized iron vessels a coarse, gritty surface. It has a flat taste, and boiling does not seem to improve it.

No. 2. From a dug well, 55 feet deep, located at the mouth of a cañon opening into the San Joaquin Valley, and about 3½ miles southwest of Bethany.

	Well No. 1.		Well No. 2.	
	Grains per Gallon.	Parts in 10,000.	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	124.12	21.25	97.25	16.65
Soluble in water after evaporation	105.13	18.00	69.51	11.90
Insoluble in water after evaporation	10.52	1.90	15.47	2.65
Organic matter and chemically combined water	8.47	1.35	12.27	2.10
The soluble part consists of—				
Sodium and potassium sulphates (Glauber's salt, etc.)	75.26	12.90	30.26	5.18
Magnesium sulphate (some)				
Sodium chlorid (common salt)	29.87	5.10	39.25	6.72
Sodium carbonate (sal soda)	----------	----------	----------	----------
The insoluble part consists of—				
Calcium and magnesium carbonates	9.93	1.70	14.89	2.55
Calcium sulphate (gypsum)				
Silica	.59	.20	.58	.10

Both waters exceed in mineral content several times the utmost limits of tolerance for saline matters in waters for domestic use. Moreover, the quality of the mineral salts is so purgative, that their continued use would infallibly engender disease of the bowels.

Artesian well water, from Semi-Tropic, Kern County; sent by S. B. Anderson.

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	90.06	15.42
Soluble in water after evaporation	79.67	13.64
Insoluble in water after evaporation	4.96	.85
Organic matter and chemically combined water	5.43	.93
The soluble part consists of—		
Sodium and potassium sulphates (Glauber's salt, etc.)	1.54	.27
Sodium chlorid (common salt)	76.38	13.05
Sodium carbonate (sal soda)	1.75	.32
The insoluble part consists of—		
Calcium and magnesium carbonates	4.96	.85
Calcium sulphate (gypsum)		
Silica		

There are no nitrates present, and the residue does not blacken on heating. The water contains only an excessive amount of common salt, the other ingredients being unobjectionable in the amount present. The salt ranges considerably beyond the limit generally admissible for irrigation, yet if used systematically, on a sandy soil, taking care to leach it every year or two by long-continued flooding, it may answer the purpose.

Well water, from M. G. Copertine, 730 Vallejo Street, San Francisco.

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	50.86	8.70
Soluble in water after evaporation	21.85	3.85
Insoluble in water after evaporation	23.01	3.94
Organic matter and chemically combined water	5.00	.91
The soluble part consists of—		
Sodium and potassium sulphates (Glauber's salt, etc.)	1.01	.19
Sodium chlorid (common salt)	17.73	3.02
Sodium carbonate (sal soda)	3.48	.64
Sodium nitrate	.63	
The insoluble part consists of—		
Calcium and magnesium carbonates	16.06	2.75
Calcium sulphate (gypsum)		
Silica	6.95	1.19

The mineral content of this water is excessive for domestic use; and their character, as to common salt and saltpeter, is such as to indicate sewage contamination.

Water from a well 80 feet in depth, opposite the Veterans' Home gate, near Yountville, Napa County; sent by Mrs. E. Frantz.

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	10.16	1.74
Soluble in water after evaporation	1.63	.28
Insoluble in water after evaporation	7.29	1.26
Organic matter and chemically combined water	1.24	.20
The soluble part consists of—		
Sodium and potassium sulphates (Glauber's salt, etc.)	1.63	.28
Sodium chlorid (common salt)		
Sodium carbonate (sal soda)		
The insoluble part consists of—		
Calcium and magnesium carbonates	1.51	.26
Calcium sulphate (gypsum)		
Silica	5.78	1.00

The analysis shows the water to be quite low in mineral ingredients, and in every way adapted to domestic use. The silica probably causes turbidity when the water is exposed to the air or boiled, but is bland and innocuous.

Well water; sent by Miss J. Clark, of Oakland, Alameda County. The sample was somewhat turbid, and had a strong odor of sulphuretted hydrogen gas.

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	42.28	7.25
Soluble in water after evaporation	6.19	1.06
Insoluble in water after evaporation	24.12	4.14
Organic matter and chemically combined water	11.97	2.05

The soluble part consists mainly of sodium chlorid (common salt), with small amounts of carbonates and sulphates of the alkalies, etc. The insoluble part is chiefly carbonates of lime and magnesia, with small quantities of gypsum, iron, silica, etc. The water is very "hard" and unfit for drinking purposes. For other domestic uses, the lime can be removed by the usual method.

Water, from Decoto, Alameda County; sent by Carlton Crane. The well from which the sample was taken is 178 feet deep. It contains 21 grains of mineral matters per gallon, nearly half of which is common salt and carbonate of soda; the other half chiefly carbonates of lime and magnesia. There is a little iron carbonate present, which makes the water slightly chalybeate in character.

Well water, from Los Gatos, Santa Clara County; sent by G. A. Butler. The sample has a flattish, insipid taste.

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	40.36	6.91
Soluble in water after evaporation	6.89	1.18
Insoluble in water after evaporation	22.14	3.79
Organic matter and chemically combined water	11.33	1.94
The soluble part consists of—		
Sodium and potassium sulphates (Glauber's salt, etc.)	1.54	.26
Sodium chlorid (common salt)	1.64	.28
Sodium carbonate (sal soda)	3.71	.64
The insoluble part consists of—		
Calcium and magnesium carbonates Calcium sulphate (gypsum)	20.27	3.47
Silica	1.87	.32

This water, while not containing any unusual amount of soluble salts, is excessively "hard" from the presence of a large amount of lime and magnesia, in the form of carbonates and sulphates. It is hardly to be recommended as a drinking water; for other domestic uses, it may be softened by the use of a little washing-soda to throw down the lime, etc. It may also be improved by the use of a definite amount of lime-water (say 1 to 20), for the same purpose.

Water from the well of Levy Hill, Los Gatos, Santa Clara County; sent by the Mountain Spring Water Company, C. M. Merriam, Superintendent. "The well is 27 feet deep, and 1,680 feet from the end of a sewer which empties into Los Gatos Creek."

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	27.50	4.71
Soluble in water after evaporation	9.20	1.58
Insoluble in water after evaporation	8.90	1.51
Organic matter and chemically combined water	9.40	1.62
The soluble part consists of—		
Sodium and potassium sulphates (Glauber's salt, etc.)	7.95	1.37
Sodium chlorid (common salt)	trace.	------------
Sodium carbonate (sal soda)	.83	.14
Sodium nitrate	.42	.07
The insoluble part consists of—		
Calcium and magnesium carbonates Calcium sulphate (gypsum)	8.50	1.46
Silica	.40	.05

The mineral content in the above water is somewhat above that regarded as the limit in potable waters, but much of that can be removed by boiling, thus removing the hardness. The amount of organic matter and nitrates, however, indicates contamination from the sewer mentioned.

Well water, from the Old Mission Ranch, one eighth of a mile from the Soledad Slough (see analysis of its water), and west of Soledad, Monterey County; sent by H. H. Tracy, of San Francisco.

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	15.49	2.65
Soluble in water after evaporation	5.27	.90
Insoluble in water after evaporation	10.22	1.75

The soluble part of the above consists chiefly of sulphate of soda (Glauber's salt), with some sulphate of magnesia, or Epsom salt. The insoluble portion comprises carbonates of lime and magnesia, with a little gypsum. The water is quite pure, and is suitable for all uses, irrigation and domestic. It closely resembles, in composition, that of Soledad Slough, which appears to come from Arroyo Seco.

Water of the Cooper well, Experiment Station at Paso Robles, San Luis Obispo County; sent by the foreman of the Station. Analysis made by P. W. Tompkins, a student in the Agricultural laboratory.

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	27.52	4.70
Soluble in water after evaporation	12.91	2.22
Insoluble in water after evaporation	10.53	1.78
Organic matter and chemically combined water	4.08	.70
The soluble part consists of—		
Sodium and potassium sulphates (Glauber's salt, etc.)	6.53	1.13
Sodium chlorid (common salt)	6.13	1.05
Sodium carbonate (sal soda)	.25	.04
The insoluble part consists of—		
Calcium and magnesium carbonates Calcium sulphate (gypsum)	8.31	1.40
Silica	2.22	.38

The above water is rather hard in character, but by the usual means may be made potable, and thus suitable for domestic use. For irrigation it is very well suited.

Well water, from the valley 2 miles west of Santa Paula, Ventura County; sent by John Thille. The well is 162 feet deep, and the water comes from under a bed of rock 11 feet thick. The water stands at 77 feet below the mouth of the well. The sample was clear, had a flat taste, and was neutral in character.

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	184.11	31.52
Soluble in water after evaporation	134.63	23.05
Insoluble in water after evaporation	34.59	5.92
Organic matter and chemically combined water	14.89	2.55
The soluble part consists of—		
Sodium and potassium sulphates (Glauber's salt, etc.)	88.59	15.19
Sodium chlorid (common salt)	46.04	7.86
Sodium carbonate (sal soda)	--------	--------
The insoluble part consists of—		
Calcium and magnesium carbonates Calcium sulphate (gypsum)	33.00	5.65
Silica	1.59	.27

This water is far too strong in mineral ingredients to serve any purpose in domestic use, being a saline purgative. For irrigation, it is, at least, twice too strong.

Well water; sent by J. B. Neff, of Anaheim, Orange County. "The well is located two miles south of Anaheim, and is 100 feet deep. The water rises to within 14 feet of the surface, and yields 1,000 gallons per minute, without any decrease of flow after being lowered 15 feet."

The water contains 18.9 grains of mineral matters per gallon. Of this about 12 grains is chiefly carbonate of lime, which is beneficial to the soil, but renders the water "hard." The rest is chiefly carbonate of soda ("black alkali"), with some common salt and Glauber's salt. The water is suitable for all ordinary domestic and agricultural uses. Its hardness can be done away with either by boiling or the addition of about an ounce of sal soda, or two gallons of clear lime-water to each barrel.

Waters, from six wells in Perris Valley, Riverside County—three from Ora Oak, Perris; one from Henry Pound, Perris; one each from W. N. Harvey and E. E. Waters, of Menifee. The results of these analyses are given in the description of Perris Valley, page 21.

Water, from Escondido, San Diego County; sent by S. M. Stewart, for an analysis, to ascertain its purity from a sanitary point of view.

	Grains per Gallon.	Parts per Million.
Solid residue	16.51	
Chlorine	.82	
Free ammonia		.414
Albuminoid ammonia		.176
Oxygen		5.12
Nitrates		None.

This water is unexceptional as far as the mineral content goes, but is evidently contaminated with some vegetable or, possibly, animal matter; doubtless from vegetation or other debris left when the water was turned into the reservoir. A similar trouble once occurred at the Sweetwater Dam, but disappeared after awhile. In its present condition this water exceeds considerably the tolerance usually allowed for ammonia and oxygen consumed in combustion of vegetable (organic) matter, and can hardly be considered safe for drinking purposes, but can be rendered so by boiling. In the course of some months, or longer, according to the amount of debris remaining in the reservoir, the water may throw off these impurities; but it should again be subjected to sanitary tests before being admitted into general use.

Well water, from Bishop Creek, Inyo County; sent by T. F. A. Connelly. The well is 18 feet deep, and tubed. The sample was clear, and had a slightly alkaline reaction. The residue from evaporation slightly blackened on ignition. Analysis made by G. K. Swingle.

	Grains per Gallon.	Parts in 10,000.
Total residue by evaporation	18.61	3.35
Soluble in water after evaporation	8.46	1.46
Insoluble in water after evaporation	7.41	1.37
Organic matter and chemically combined water	2.74	.52
The soluble part consists of—		
Sodium and potassium sulphates (Glauber's salt, etc.)	7.42	1.31
Sodium chlorid (common salt)	.68	.11
Sodium carbonate (sal soda)	.36	.04
The insoluble part consists of—		
Calcium and magnesium carbonates	4.67	.85
Calcium sulphate (gypsum)		
Silica	2.74	.52

This is a very good water, and well adapted to domestic and irrigation uses.

IV. ROCKS, CLAYS, MARLS, COALS, AND PLANTS.

During the past year the examination of specimens of rocks, minerals, etc., sent into this office has been merely for purposes of identification, and for judgment as to practical value for agricultural purposes. The Station has neither the time nor the means for the assay of ores and minerals not bearing directly upon agricultural interests.

MINERALS, ROCKS, ETC., SENT FOR IDENTIFICATION.

Article.	Sent by.	Address.	County.
Nitrate of soda, native			
Plumbago	G. N. Adkins	Vista	San Diego.
Banded jasper	M. Macdonald	Riverside	Riverside.
Lignite	Jas. Stevens	Sisson	Siskiyou.
Iron ore	Jas. Stevens	Sisson	Siskiyou.
Limestone	Jas. Stevens	Sisson	Siskiyou.
Marl	L. B. Benchley	Fullerton	Orange.
Brown coal	Jas. Fitzpatrick	Antioch	Contra Costa.
Iron pyrites	Jas. Fitzpatrick	Antioch	Contra Costa.
Limestone	J. H. McKnight	South Riverside	Riverside.
Silica	J. H. McKnight	South Riverside	Riverside.
Clay (4)	J. H. McKnight	South Riverside	Riverside.
Marly clay	Dr. T. C. Stockton	San Diego	San Diego.
Marl	L. W. Goff	Chula Vista	San Diego.
Claystone	J. W. Brownell	Orland	Glenn.
Steatite	H. D. Long	Porterville	Tulare.
Calcareous tufa	R. P. Sibley	Ontario	San Bernardino.
Serpentine	Erb. Voice	Cadogan	Fresno.
Infusorial earth	Erb. Voice	Cadogan	Fresno.
Sandstones (2)	Geo. A. Miller	Arbuckle	Colusa.
Clay	Geo. A. Miller	Arbuckle	Colusa.
Selenite	Geo. A. Miller	Arbuckle	Colusa.
Hornblende	Geo. A. Miller	Arbuckle	Colusa.
Limestones (2)	J. H. Henry	San José	Santa Clara.
Jasper	J. H. Henry	San José	Santa Clara.
Marls (2)	J. H. Henry	San José	Santa Clara.
Chrysotile	J. H. Henry	San José	Santa Clara.
Black sand	Mary J. Tyler	Porterville	Tulare.
Carbonate of lime	H. Sontag	Cucamonga	San Bernardino.
Quartz, etc.	H. Sontag	Cucamonga	San Bernardino.
Marl	Y. R. Stevens	Huron	Fresno.
Earth	Y. R. Stevens	Huron	Fresno.
Clays (4)	S. B. Wright	San Bernardino	San Bernardino.
Siliceous limestones (4)	Louis Glichner	San Diego	San Diego.
Siliceous claystone	W. W. Butler	Oceanside	San Diego.
Black jasper	W. W. Butler	Oceanside	San Diego.
Limestones (3)	S. F. Woodworth	Clipper Gap	Placer.
Calcite	S. F. Woodworth	Clipper Gap	Placer.
Volcanic ash (2)	S. F. Woodworth	Clipper Gap	Placer.
Volcanic ash		Amsterdam Col'y	Merced.
Alabaster	Ed. Bean	Santa Margarita	San Luis Obispo.
Rock	Ed. Bean	Santa Margarita	San Luis Obispo.
Limestone	Ora Oak	Perris	Riverside.
Marls (2)	C. G. Austin	Simi	Ventura.
Chalky limestone	Geo. A. Williams	Klinefelter	San Bernardino.
Earth	J. A. McClung	Selma	Fresno.
White clay	A. Berg	Round Mountain	Shasta.
Sediment from boiler	W. D. Crow	San José	Santa Clara.
Limestone	V. Roberts	Alcalde	Fresno.
Fossil wood	C. H. Paterson	Carlsbad	San Diego.
Lava	C. H. Paterson	Carlsbad	San Diego.
Limestone	C. H. Paterson	Carlsbad	San Diego.

PLANTS, ETC.

Article.	Sent by.	Address.	County.
Strawberry	E. Luehning	Newcastle	Placer.
Fiber of silkweed	J. S. Brooks	Delano	Kern.
Thistle	Mrs. E. Ketchum	Stockton	San Joaquin.
Plants	Paul Keyser	San Francisco	San Francisco.
Plants	Sacramento Drying Co	Sacramento	Sacramento.
Cañaigre	A. B. Leckenby	Bakersfield	Kern.
Mallow plant	A. B. Leckenby	Bakersfield	Kern.
Chemisal	E. H. Hastie	San Francisco	San Francisco.
Cañaigre	L. H. Filcher	Weed-Patch	Kern.
California heliotrope	C. Gelardin	Pleasanton	Alameda.
Mealy mallow	C. Gelardin	Pleasanton	Alameda.
Grass	L. F. Gay	Piru City	Ventura.
Napa thistle	L. F. Gay	Piru City	Ventura.
Chard	Geo. A. Hastings	Benicia	Solano.
Licorice root	A. T. Denotovich	Fresno	Fresno.
Essential oils	E. A. Zumbro	Riverside	Riverside.
Chickweed	C. W. Gammon	Walnut Grove	Sacramento.
Citrus leaves	G. W. Duncan	Daunt	Tulare.
Cañaigre	H. D. West	Bakersfield	Kern.
Cañaigre	D. E. Josephi	San Francisco	San Francisco.
Lotus	J. H. Elkinton	Selma	Fresno.
Loco weed	F. A. Armstrong	Moreno	Riverside.
White clover	S. K. Renna	Clipper Gap	Placer.
White dock	C. M. Fenn	San Diego	San Diego.
Soft brome grass	J. S. Elles	Hullville	Lake.
Clover	J. S. Elles	Hullville	Lake.
Silene gallica	F. Gates	Monterey	Monterey.
Napa thistle	J. H. Zacharias	Crow's Landing	Stanislaus.
Leaf of carob tree	J. W. Brownell	Orland	Glenn.
Cañaigre	Ivan Peratsky	Hollister	San Benito.
Iva axillaris	Ivan Peratsky	Hollister	San Benito.
Milk thistle	Ludwig Von Roesfeld	Evergreen	Santa Clara.
Sweet clover	H. F. Milliken	Fort Bragg	Mendocino.
Canary grass	H. F. Milliken	Fort Bragg	Mendocino.
English ray grass	H. F. Milliken	Fort Bragg	Mendocino.
Napa thistle	E. W. Morse	Alpine	San Diego.
Oriental sycamore	H. Hunt	Traver	Tulare.
Napa thistle	J. B. Compton	Williams	Colusa.
Lance-leaved rib grass	A. M. Coomes	Cloverdale	Sonoma.
Thistle	D. M. Field	Coulterville	Mariposa.
Bermuda grass	J. W. Dutton	Dutton's Landing	Solano.
Sorghum halepense	J. W. Dutton	Dutton's Landing	Solano.
Alkali grass	J. W. Dutton	Dutton's Landing	Solano.
Alfalfa	J. W. Dutton	Dutton's Landing	Solano.
Marsh grass	J. W. Dutton	Dutton's Landing	Solano.

V. IMPROVEMENT AND FERTILIZATION OF LAND.

By E. W. HILGARD.

NATURALLY FAULTY LANDS, AND THEIR CORRECTION.

The frequency with which this Station is called upon to give advice concerning the correction of lands found to be faulty in respect to their cultivation or production, renders it desirable to formulate some general explanation in regard to the most common causes of such faultiness, which can very frequently be recognized and remedied by the farmer without individual advice.

Not many years ago it was the custom to ascribe the languishing or death of trees and crops to some "poison" contained or generated in the soil. In California, the poison theory still maintains itself to some extent in ascribing the trouble observed to "alkali," even though no manifestations of that substance may ever appear on the surface. On this point, it may as well be stated right here, that unless a soil at the end of the dry season shows a white crust or dust of alkali salts on the surface, there is no reason whatever to suppose that alkali has anything whatever to do with injury to the crop or trees; for such injury is scarcely ever done to the roots *in* the soil, but almost always by the accumulations of alkali salts near the surface.

Leaving aside the case of special diseases, such as are due to the action of fungi, insects, or other organisms; it has now become usual, in this State at least, to attribute any faulty or defective growth of culture plants to some chemical defect in the soil, and to address to the Station the question what fertilizer should be used to make up the deficiency.

Examination of the Subsoil.—Now, extended investigation of our soils has shown that, in California far more than in the Eastern States, very few soil materials exist that would not naturally produce good crops for some eight or ten years without fertilization, provided they are of sufficient depth and are adequately supplied with moisture. When, in orchard or vineyard, it is noticed that, after growing well from three to five years, or even longer, the trees or vines begin to languish, and sometimes even to die, it is not, as a rule, reasonable to conclude that it is for want of any needful ingredient in the soil. In our dry climate, depth of the soil is of the first importance, since the roots of culture plants must go deep in order to be secure against the summer's drought. As the latter renders the surface soil, which in the humid region is the main source of supply to plants, practically unavailable during a large part of the season of growth, it is clear that here, more than anywhere, the *depth and quality of the subsoil* is of the first importance, and should be investigated in all cases by the intending purchaser of land before investing. The omission of this simple precaution has led to untold losses and disappointments, which have been the more frequent as the formation of a "hardpan" at a depth more or less corresponding to the penetration of the annual rainfall, is of unusually frequent occurrence in this State. The richest surface soil may be utterly useless for farming purposes if underlaid, at a depth varying, according to the nature of the soil, from one to four feet, by a hardpan impervious to the roots of plants. As a rule it is not practically feasible to maintain, even by irrigation, a proper supply of moisture in a soil limited in depth by hardpan at two or three feet, even in cases where the roots of the crop do not habitually penetrate beyond that depth; in the case of fruit trees and vines (the roots of which in certain lands are limited only by a depth beyond fifteen or twenty feet) the objection to such lands in their natural condition is insuperable.

Outside of adobe tracts an exceedingly simple and effective device for subsoil examination is a steel rod not less than a quarter of an inch in diameter (round or square, preferably the latter), well pointed at one end, and provided at the other with a stout iron ring for the reception of a stout cross-handle, such as is used for post-hole augers. With such a prod or sounding rod, not less than five feet in length, the exploration of the subsoil for hardpan or dense clay layers becomes a matter of a few minutes; and a few hours' time suffices to thus explore extended tracts, and perhaps save bad investments of thousands of dollars; or at the very least, to convey very valuable information as to the probable defects or virtues of the land, not only with respect to root penetration, but also with regard to irrigation, drainage, etc. It is easy also to detect thus the presence of underlying layers of quicksand, gravel, or other loose materials through which irrigation water would waste, or which would prevent the rise of bottom water within the reach of plant roots, by the large interspaces between their grains. Any remaining doubts as to the nature of such underlying materials at particular points can then quickly be solved by the use of a post-hole auger. The latter serves also most conveniently for the taking of samples to be submitted for examination by the Station; but it should be remembered that in no case should any sample represent the average of more than one foot in depth; and that, whenever a material change to resistance to the auger's penetration is observed, the depth at which such change occurs should be noted, and a sample taken of the material causing such change, again not to exceed in any case the additional depth of one foot. The extreme depth to which the boring and taking of samples should reach depends not only upon the nature of the soil, but also upon that of the crop expected to be planted. The tap-root of a pear tree will in almost any soil require a depth of six feet at least, to be normally developed, hence pear trees should never be planted in shallow soils; almonds and peaches, on the other hand, will be content with half that depth, if necessary, provided the soil be rich enough and the supply of moisture adequate.

In coarse, gravelly soils, as well as in hard adobe, it may become necessary to use the pick and spade (not shovel) to dig a hole of sufficient width and depth for observation and for the taking of samples to be examined. In digging such holes the same rule should be observed as above given for the post-hole borings.

Bottom Water.—But it is not hardpan, tough clay, quicksand, or gravel only that the sounding prod and post-hole auger should be used to discover. In low-lying lands and in irrigated lands generally, it is of the utmost importance that the exact level of the bottom water at different points should be known; for the bottom water limits the penetration of roots as effectually as the hardest hardpan or rock stratum. No root of cultivated crops can live when submerged in water or liquid mud for any length of time, save in the case of such crops as rice, and a few others. In the case of all fruit trees the penetration of the roots is absolutely limited by the water level; more than this, while the root may adapt itself to a permanent water level at a shallow depth, and the tree may continue to flourish if well fertilized, a frequent variation in the water level is almost certain to be fatal to ordinary tree growth. For, if the root has been afforded opportunity to extend downward, and is then submerged for a length of time, ranging from thirty to sixty days in different species, it will become diseased, and the disease or decay communicating itself to the healthy portions above will inevitably cause the tree to become at least unprofitable, and perhaps to languish or die. The rise of irrigation water from leaky ditches to within a few feet of the surface would be bad enough if the level were kept constant, because of the shallowing of the soil that can be utilized by the plant. But when the water level is subject to frequent variations, it is impossible for the plant to adapt itself to varying conditions, and the drowning out and decay of roots, just referred to, will inevitably occur in a longer or shorter time.

Even aside from the case of alkali lands, this is one of the commonest causes of injury to orchards in irrigated districts; nor is there any imaginable remedy for it, except the abatement, as a public nuisance, of the leaky ditches which cause the injury; unless, indeed, the heroic remedy of surrounding each individual property with a drainage ditch six or seven feet deep, be resorted to, as has been successfully done in a number of cases.

When to the injury from the water itself there is superadded that which arises from the carrying to the surface of the alkali which has remained distributed through many feet of subsoil in the natural condition of the land, the damage is greatly aggravated, frequently to the extent of rendering the land valueless for any profitable crop, after the plantations of trees and vines have been killed, partly by drowning, partly by alkali corrosion.

In almost all the cases described above, fertilization of any kind is absolutely useless; and, as the experience at this Station shows, in about nine cases out of ten brought to our notice, the faults complained of have no connection whatever with any lack of plant-food that could be remedied by fertilization.

As regards injury from the rise of bottom water: It is plain that unless drains were laid at the depth to which the roots of fruit trees should reach to insure production of full crops, the only remedy is the abatement of the rise by stopping its source; whether it be a leaky ditch or an overflowing stream, whose flood-waters keep the soil saturated until late into spring or summer. In the latter case, the land must simply be considered as unfit for orchard purposes, or for the growth of any but shallow-rooted field crops. For shallow-rooted trees such as cherries, and for small fruits, the laying of drains at three to four feet depth will generally effect an adequate degree of drainage. Curiously enough, the laying of underdrains will sometimes be effectual, even in the case of injury by certain kinds of hardpan, which gradually becomes disintegrated by the frequent alternations of wet and dry caused by the drains. Lands solidly underlaid by hardpan may thus, in the course of some years, become adapted to deep-rooted field crops, and even to orchard trees and vine culture. This is especially true of some kinds of clay hardpan.

Hardpan.—But when trees are to be planted on land either wholly or partially underlaid by hardpan of any kind, the best and cheapest method of assuring the welfare of the trees, and the proper penetration of their roots for moisture and plant-food, is to explode near the lower limit of the hardpan layer a cartridge of giant powder (ordinarily a half-pound one of No. 2), which shatters the hardpan to an extent and in a manner impossible to obtain by any mechanical digging or the use of the crowbar. Those in good practice sometimes superadd to the giant powder a pound or so of black powder, which throws out the earth, so as to make the hole ready for setting the tree. Trees thus planted rarely suffer again from the effects of hardpan.

But even trees already planted, if found to be suffering from that cause (unless it be preferred to plant *de novo*), may usually be relieved from stress without serious injury by exploding two or three smaller cartridges (¼ lb.) within two and a half or three feet of the trunk. While some roots are inevitably injured in this way, yet as a rule the damage done is not so great as to not render this preferable to the replacement of a tree two or three years old by a new one; provided only, that the operation has not been deferred until the tree becomes unhealthy; and also that the depth to which the cartridge is placed, and its strength, be properly adapted to the nature of the soil. Preliminary trials must be made to determine what a given cartridge placed at various depths in the soil, will do in the existing condition of moisture; for the earth must not be blown out of the hole, taking the roots with it, but simply so shaken and shattered that drainage and root penetration will become easy. In a wet, pasty, adobe soil, for example, it would be impossible to make the explosive work to any advantage. It will simply make a round pit with compacted sides, and if strong enough, throw out a solid lump or scattering pellets, as the case may be; while the same soil in a dry state would be most thoroughly and effectually shattered in connection with any hardpan underlying it. In light, sandy soil, on the contrary, a cartridge placed too shallow will simply send a shower of sand over the neighborhood, with but little shattering effect; while, if placed at the right depth, it will be found to produce simply a slight general bulge of the ground, indicating the increase of bulk, brought about by the explosion in the loosening of the subsoil.

While farming with dynamite may seem to some a precarious and unprofitable undertaking, it is certain that there are numerous cases in which the vexatious interruptions of cultivated areas can be successfully dealt with in no other way. It certainly would not be advisable for any one to undertake to reclaim large tracts of hardpan land with giant powder, so long as there is plenty of good land at command; its use will naturally be the exception, and not the rule.

Coarse, Sandy Lands.—In the granitic areas of Southern California it is not uncommon to find otherwise desirable tracts of land, whose surface is composed of coarse granitic sand and debris, within which the circulation of the hot and dry summer air is so free that culture plant roots cannot live in it, and hence shallow-rooted plants, even when transplanted from the nursery, cannot be made to succeed. If, for any reason, it becomes desirable or necessary to utilize such lands for agricultural purposes, regard must be had to the fact that the coarse surface materials are to be regarded not as soil, but only as a mulch; that, therefore, when trees are set out, they must be placed at such a depth as will withdraw their root-system from the injurious drying effect of the summer heat, enabling them to reach quickly the moister and usually closer-textured substrata. The practice of the Arabs in planting their date palms in deep, permanent pits sunk in the sand of the desert, is a good precedent in such cases; but the cultivation of garden vegetables is, of course, impracticable on such lands, nor is it usually practically feasible to render such soils adapted to garden culture without incurring expenses too heavy for any but fancy work.

CROPS FOR GREEN-MANURING.

Objects of Green-Manuring.—Before discussing the question of the adaptation of particular crops for green-manuring, it is necessary to consider what are the objects to be accomplished by the practice of growing crops for the express purpose of turning them under while green, causing them to decay in, and to be incorporated with, the soil.

Soils in their natural state are kept in a condition of permanent and mostly of constantly increasing fertility by the incorporation of the whole or a part of their vegetation with the soil, each year. Thus, in the case of annuals the entire plant, in that of forest trees the leaves, are annually returned to the soil. If we were to do the same with our annual crops, the cultivated soils would continually increase in productiveness, but we would have nothing to sell from the farm. To the extent to which we sell the products of the soil, returns will ultimately have to be made so soon as the first flush of fertility of virgin soils is over.

Green-manuring is intended to return to the land the entire mass of one crop, for the benefit of one or more succeeding ones. It is evident that in doing this we expend, in seed and cultivation, a certain amount of money which might have been used for the purchase of fertilizers instead; and that, therefore, it is very important that the benefits to be derived from either mode of expenditure be fully considered, and action taken accordingly. If, for instance, the growing of a green-manuring crop involves the loss of one entire year's time and market crop, it may prove more expensive than the purchase of a fertilizer, producing the same effect.

Selection of Crops for Green-Manuring.—We will first of all, then, look for a crop of rapid development, which can be grown between harvest and seeding time, if possible; or, which at least will, after one cutting, still grow a sufficient mass of vegetable matter to render its turning-under a paying operation. In some cases, the mass of roots remaining in the soil after harvesting the tops would alone repay the outlay.

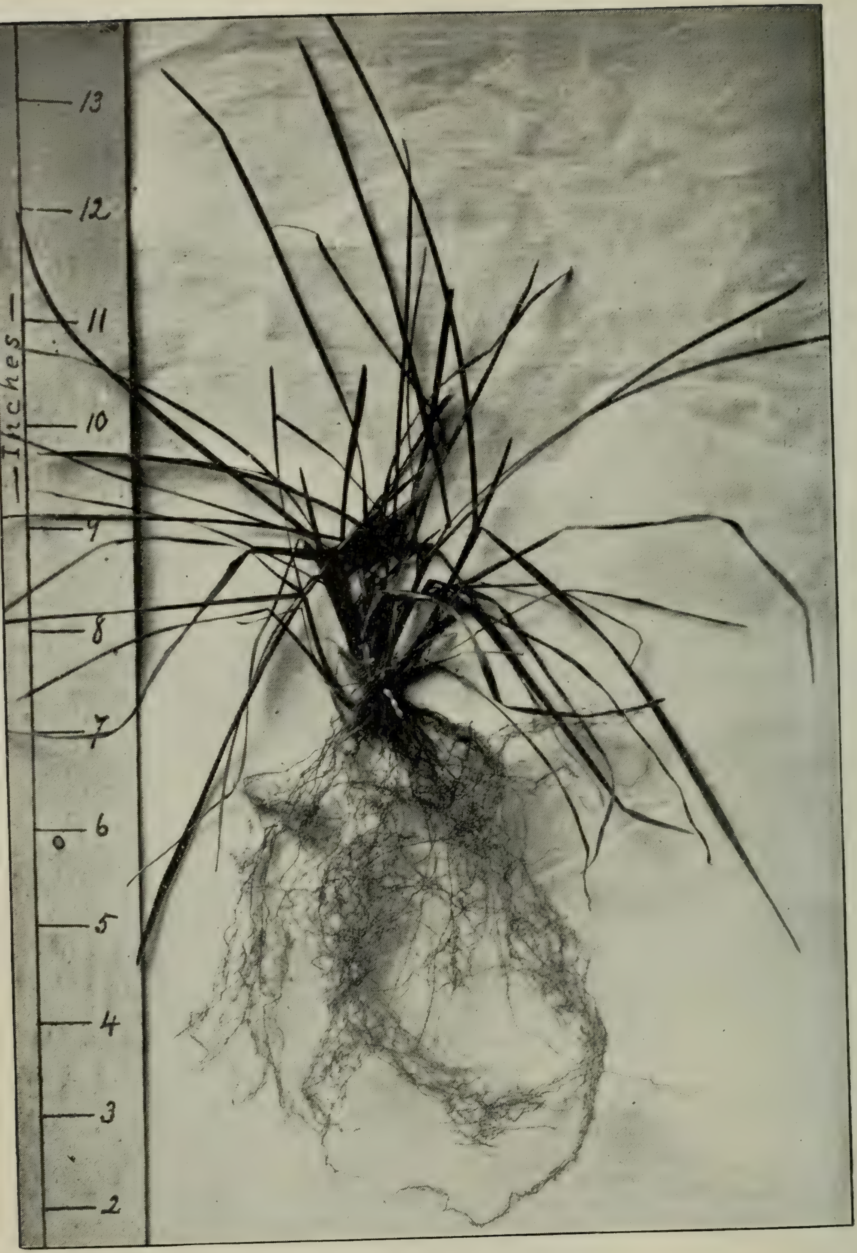


Plate 1. Blue Grass and Roots.

The next point we should consider is, that the mass of vegetation to be plowed-in should be as large as possible.

And, finally, we should seek for plants that will not only return to the soil that which they took from it, but something more, by way of interest on the investment.

It is true that since all plants take the bulk of their vegetable (combustible) matter from the air, to that extent all plants return to the soil more than they took from it. But the value of the vegetable matter as a soil-improver varies very greatly with the kind of plant grown; besides, it is evidently desirable that the substance of the plant so used should, as far as possible, be taken from a soil layer different from that which is especially drawn upon by the coming crop. The grains and true grasses, with their shallow roots, draw chiefly upon the surface soil; hence, the green crop intended for their benefit should, in the main, be made to draw upon the subsoil, by the choice of deep-rooted plants.

These simple considerations at once condemn, as least likely to be effective in green-manuring, the use of rye and other cereals or true grasses. In their decay they give to the soil little or nothing beyond what was already in the surface soil and within reach of the succeeding crop, aside from the purely vegetable matter, which in their case is of the least valuable character. The loosening of a compacted soil deficient in vegetable matter is usually the most valuable effect of green-manuring with grasses, and may be extremely useful in the case of orchards that have been kept clear of weeds for years.

The subjoined figure of a blue grass plant, with roots freed from adhering soil, show the fine fibrous nature and shallowness of the root-system; and may be considered typical of the root-system of cultivated grasses generally.

True vs. "Artificial" Grasses.—But it must be distinctly understood that this is true only of the *true* grasses, and not of the large class of forage plants generally, which by a most mischievous perversion of the natural and instinctive recognition, by even a child, of any true grass, has been jumbled together into a heterogeneous mass by the invention of "artificial grasses." It is high time that this vicious usage, which happily has not become "time-honored" as yet, should give way before the recognition of the radically important differences in the agricultural functions of the several classes of forage plants, which must be discriminated by any one desiring to avail himself of the knowledge which the intense competition of to-day renders indispensable if agriculture is to be a paying pursuit.

Deep-Rooted Crops.—It being understood that under all circumstances deep-rooted crops are preferable to shallow-rooted ones for green-manuring, the question arises whether there is any reason for discriminating closely among the former. There are many tap-rooted plants of rapid development which might answer the purpose, such as mustard, buckwheat, etc.; and there is another class not usually tap-rooted, but nevertheless penetrating to great depths, embracing the clovers (inclusive of alfalfa), vetches, peas, beans, lupins, and generally the plants now commonly known as legumes, or leguminous plants, having flowers resembling those of the pea and clover.

It is well known that for a long time past the clovers have been used as soil-improvers in practical agriculture; usually preceding grain crops. Until within recent years the exact cause of the preference given to this class of plants for green-manuring was not understood. It is now well recognized and definitely settled by numerous critical investigations and experiments that these plants (the legumes) have the peculiarity of taking from the air almost their entire supply of nitrogen, the most costly of all soil ingredients required by crops, and forming a large part of the farmer's outlay for fertilizers. The same is not true of any other of the deep-rooted crops; at least not remotely to the same extent, if at all.

Peculiarities of the Roots of Legumes.—All these plants are deep-rooted; some having tap-roots, while others—like peas and beans—send out bunches of cord-like roots into the subsoil, from which the smaller roots branch out. An examination of these roots, while in active growth, shows in almost all cases that they are, to a greater or less extent, infested with small tubercular excrescences, deforming the root fibriles, and sometimes the main roots themselves. These excrescences are found in nearly every individual of any kind of naturally growing legume; except, usually, in the case of very poor or etiolated plants. A multitude of experiments has proved that their presence is a necessity for the thrifty growth of the legumes. Their forms and distribution on the roots, as well as their relative abundance, vary greatly with different species.

Microscopic examination of the tubercles shows them to be filled with great numbers of minute organisms (bacteria), among whose life functions is the taking up of the free nitrogen of the atmosphere; and that the host plant takes up from them the nitrogen it requires for its own use, so as not to need any outside supply of nitrogenous fertilizers. The latter, in fact, have for some time been known to be ineffectual, or at least not effective enough to pay for their use in the case of leguminous crops.

The accompanying figures show the roots, more or less covered with excrescences, of three different plants of the legume family. Plate 1 shows the roots of the "square-pod pea," described in detail below; Plate 2, that of the "snail clover," also discussed farther on as to its usefulness in green-manuring. Plate 3 shows the root tubercles formed on the fresh summer roots of a black acacia tree in consequence of severe root-pruning. It will be seen that in these different roots the habit of the tubercles is quite different; rather regularly distributed in the square-pod pea, in the snail clover gathered together in a few bunches, in the acacia strung along irregularly, and varying greatly in abundance and form. Such being the case, it is not unnatural to conclude that bacteria forming the tubercles of different plants are not always the same. As a matter of fact, while they are very much alike in their forms, experience has shown that they will not act interchangeably on the several plants; that, for instance, the bacteria of the acacia are ineffectual in forming the tubercles on clovers and peas, nor will those of the lupins serve, e. g., for the clovers. Since, then, these plants are dependent for their nitrogen-supply on the presence of these bacteria, it is presumable that they will grow best on soils containing an abundance of them; and this presumption has also been abundantly verified by experiments both on the small and large scale, which showed convincingly that when land to be sown to clover is "inoculated" by

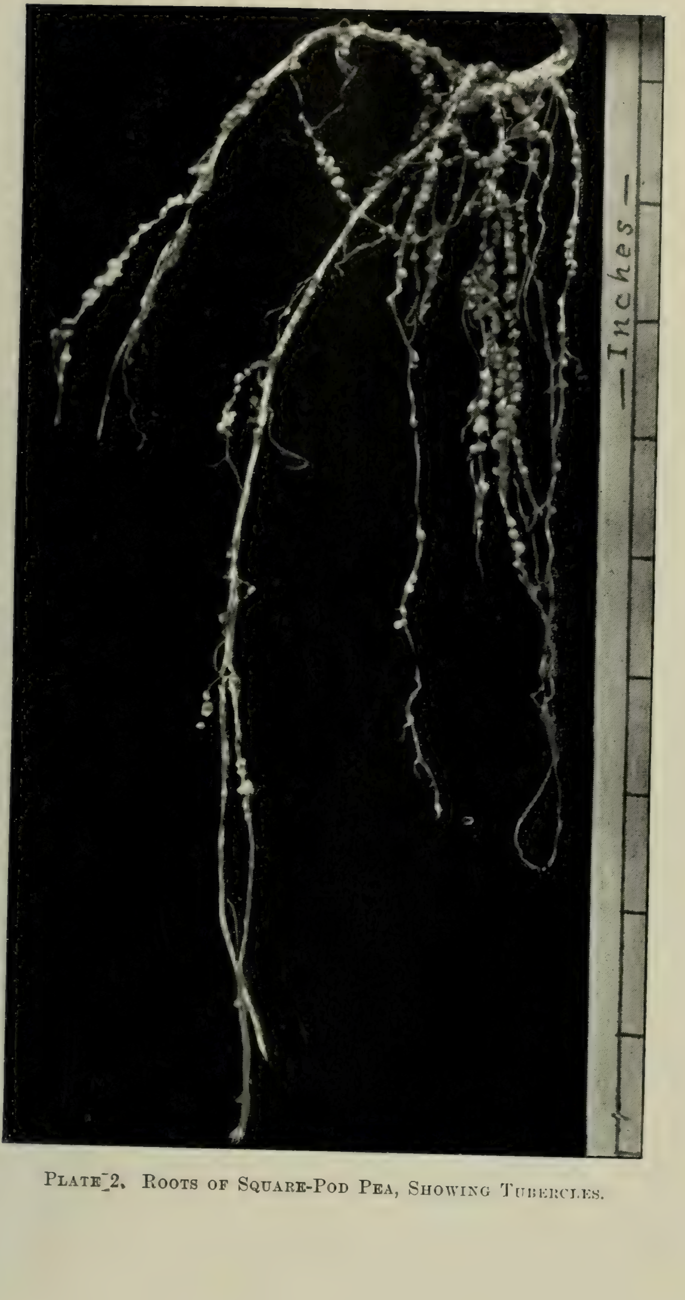


PLATE 2. ROOTS OF SQUARE-POD PEA, SHOWING TUBERCLES.

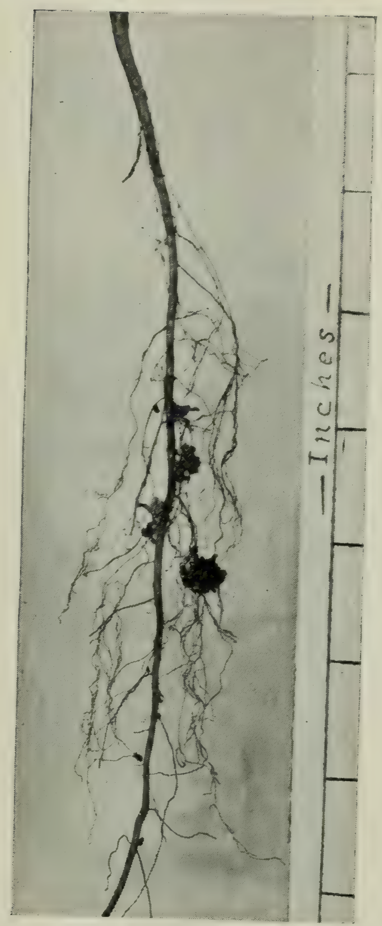


PLATE 3. ROOTS OF SNAIL CLOVER, SHOWING TUBERCLES.

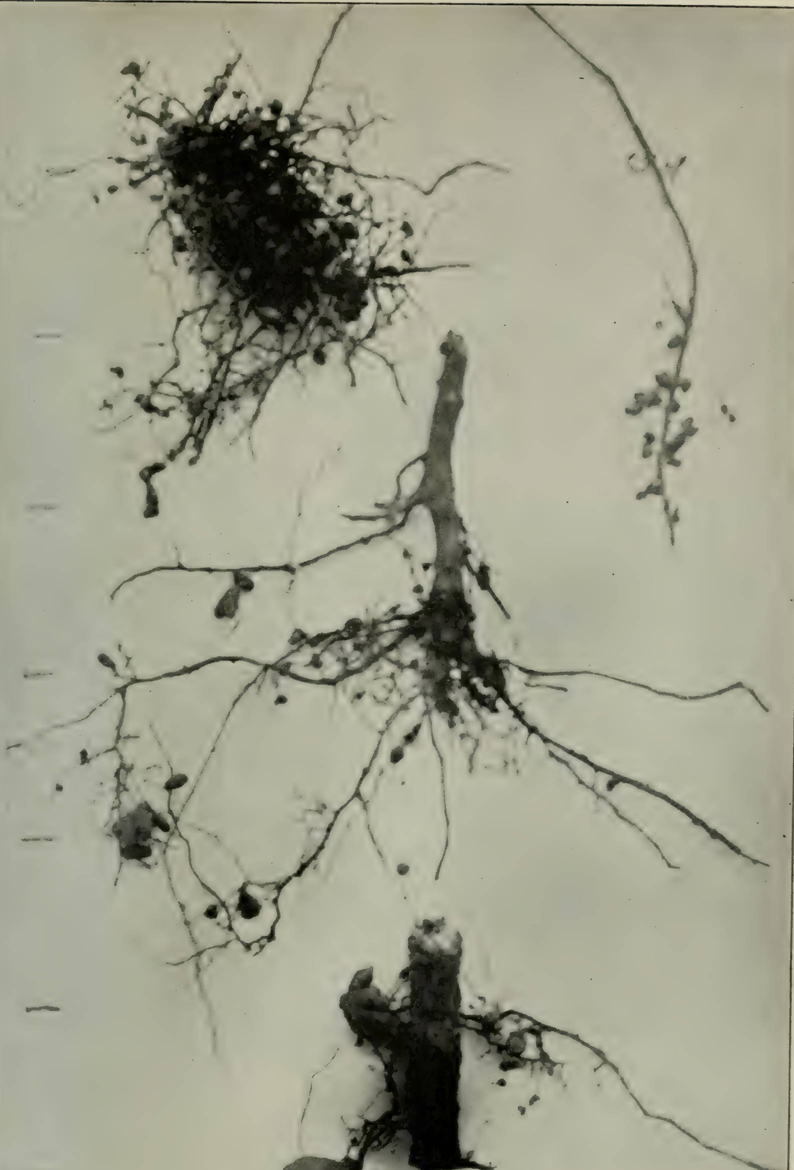


Plate 4. Root Tubercles, Black Acacia
Natural size.

being mixed with a small proportion of soil from a thrifty clover field, the clover crop will be much superior to that on similar land which has for several years borne non-leguminous crops, such as grains, turnips, etc., and has not received any of the clover earth.

These details are given in order that the farmer may understand why, under certain conditions, the legume crops may fail on different portions of one and the same field on which a good stand has been obtained, but which had previously been occupied by various crops. It thus also becomes intelligible why the legumes cannot be successfully grown on land or spots tainted with any disinfectant, or other compounds likely to be injurious to the minute organisms. I have rarely seen leguminous plants naturally growing on soils tainted with "black" alkali to any considerable extent, and even the almost neutral salts contained in the soil of the ten-acre experimental tract at Chino (see the report on the Southern California Station below) seem to prevent the normal development of all of the numerous cultivated legumes tried there, most of which, however, were of shallow-rooted and small-seeded kinds.

It is well known that alfalfa succeeds well even on lands somewhat heavily charged with alkali; this is doubtless attributable to its habit of deep rooting, which, taken in connection with the knowledge we have obtained of the manner of distribution of alkali salts in soils impregnated with them (Bulletin No. 108), explains its success. For the tap-root of alfalfa will grow straight down, without throwing out side roots, to a depth varying in different soils, without forming any of the bacterial execrescences; these being formed only on the deeper roots, are below the limit of dangerous accumulation of alkali salts, and thus, when a stand is once obtained, what with this circumstance and the thorough shading of the ground, alfalfa can be successfully grown for years on land too strongly impregnated for the success of cereals or grasses. When, therefore, green-manuring is called for on such lands, no better crop than alfalfa can be chosen, and in many cases none other will succeed. The difficulty of plowing-in alfalfa can be overcome by the use of sharp, hard-steel plowshares, and if these are run sufficiently deep, but few roots will sprout the next season. I do not know, thus far, of any other legume well adapted to green-manuring of alkali lands.

Our native lupins, as well as those cultivated in Europe, deserve special trial for the purpose of enriching soils in nitrogen. In the case of the cultivated lupin, experiments made by Professor Orth, of Berlin, proved that nearly two thirds of the total vegetable substance of this plant remains in the soil with the root-system, and that it is therefore peculiarly adapted to the object to be attained, despite its relatively small mass of stem and foliage. Tests in the cultivation of this plant have been made at the Southern California Station, as well as by the Chino Ranch Company, during the year 1895, and will be reported upon hereafter.

Green vs. Dry Vegetation for Plowing-In.—While it is true that dry hay, for instance, contains the same ingredients of plant-food as the green grass, yet there is a notable difference in the rapidity with which the substance of the two becomes available to plants. Vegetation plowed-in green decays much more rapidly and completely than when once dried, and becomes more uniformly distributed in the soil.

But the case of straw differs still more widely from that of the green cereal, for the reason that by far the greater and most important part of the plant-food has been carried into the seed or grain; there is the same difference in the value of straw for this purpose as there is for the feeding of cattle. It possesses value for either use, but not nearly as much as the green-cut hay. The same applies, of course, to fallen leaves of any kind; they have been relatively depleted of their most valuable ingredients before they were dropped by the plant; yet leaf mold is, of course, very much richer in plant-food than common soils, and the more so the greener the leaves when detached from the parent plant. Thus, in the case of ramie, beets, and many other crops, a very large proportion of the entire amount of ingredients taken from the soil is returned when the green foliage or tops are given back in harvesting; and it is of the utmost importance to the maintenance of soil-fertility that such returns be made to the fullest extent possible.

Green-Manuring vs. Stable Manure.—Not long ago there appeared in many agricultural papers, articles condemning green-manuring as a wasteful procedure as against feeding the crop to farm animals, and using the manure thus produced. The reasons for this advice were, first, the higher manurial value of the stable manure; and second, the profit derived from the animals fed.

This, of course, presupposes that stock-raising is profitable under all circumstances. But when specialties like fruit or grape-growing are concerned, it is often very doubtful that a combination with the feeding of any but the animals actually required for farm work would be at all advisable.

Again, it is presupposed that the manurial value of the green feed is fully maintained in the corresponding manure. This, however, is very far from being actually the case in practice; very few farmers take such care of their manure-pile as to even approximate to such a conservation. Often fully 50 per cent is lost.

Late experiments reported by the "Deutsche Landwirthschaftliche Presse," the leading agricultural paper of Germany, show, in addition, some surprising results, which, while incontestable, are not even yet fully understood. It appears that culture-tests made for five and nine years, respectively, by two noted observers (Jul. Kuhn and Paul Wagner), have shown that the average proportion of nitrogen actually utilized by crops grown on land fertilized with stable manure, rarely exceeds 24 per cent of the total nitrogen thus introduced; while of Chile saltpeter, fully 66 per cent, and of green-manure, 50 per cent, were harvested in the crops.

It is true that, theoretically, such returns would be made to a but slightly diminished extent, if the foliage were first fed to cattle and the manure returned to the land; and green-manuring has been very loudly and confidently condemned as a poor mode of soil-improvement on that score. But these objections presuppose not only that every farmer and fruit-grower raises cattle enough to consume such offal, but also that the whole of the manure is utilized; both suppositions are wide of the truth, especially in California. Green-manuring is most especially called for in orchards, which with us are commonly kept in such a clean state that their vegetable mold, and with it the nitrogen of the soil, is in the course of a relatively short time so far depleted that returns must be made. But fruit-growers rarely keep more stock than is needful for the work of cultivation, and for the house-supply of dairy products; and the labor of growing the crop, feeding to stock, and then curing and returning the manure, is no part of their regular business; moreover, the perfect conservation of what manure is produced, is an art as yet but little understood, and even less practiced, here. What with the losses so incurred, and the extra investments required for the production of manure, it is safe to say that few would, in actual practice, find more profit in entering upon that policy than by the direct return of the crop to the exact point where it is most needed; that is, by growing the crop in the orchard during the winter, and plowing it in in spring or early summer.

THE FERTILIZATION OF LAND.

When it has been ascertained that the failure of the lands to produce satisfactorily is not due to physical faults, and is not adequately remedied by the return of the offal of crops and green-manuring, the use of fertilizers becomes a necessity. It is not, of course, advisable to await any actual serious decrease in the natural production before resorting to remedial operations; for if the decrease has once been allowed to go beyond a certain point, the restoration of production usually involves so heavy an outlay at one time as to embarrass the farmer, aside from the loss of production in preceding years. While it is true that there are lands that may not require fertilization for centuries, if at all, such cases are few and, on the whole, easily predicted by the examination of the soils and climatic conditions. In California, they are, so far as known, confined to certain alkali lands. In all other cases, the need of fertilization may be expected to arise within from five to twenty years, according to the nature of the land, and kind and intensity of production thereon. In a few cases, this need will be found to exist at once.

In most of the newer States in this country, the old settlers have been hard to convince that fertilization would ever be needed; and for many years it has been maintained that "manuring is too costly, and will never pay." To this assertion it may be summarily answered that "manuring *must* pay, or the land must become a wilderness, and the population must abandon it, or starve." This is the lesson which has been taught over and over again by history, with only the rare exceptions that prove the rule, as in the case of the Nile delta in Egypt, and certain portions of India and China.

It is unnecessary to discuss, in this place, the history of agriculture, which has led to the present universal recognition of the principles upon which the maintenance of the fertility of land must be based, and which has led to marvelous development of the manufacture of commercial fertilizers, after the futility of the old system of "cattle-raising for the production of enough manure" had been established, both by theory and practice.

Since stable manure represents, as a rule, a portion of the offal of the farm products, its return to the soil is a matter of course, in conformity with the general principle that "everything not profitably salable, that the farm produces, should be returned to the land." Where

AMOUNT OF SOIL INGREDIENTS WITHDRAWN BY VARIOUS CROPS. (Pounds per acre.)

	Potash	Soda	*Lime*	Magnesia	Brown Oxid of Manganese	Iron Oxid and Alumina	*Phosphoric Acid*	Sulphuric Acid	Silica	Chlorine	Total Ash	*Nitrogen*
GRAPES, 1,000 lbs.	**5.00**	0.10	**1.00**	0.40			**1.52**	0.50	0.30	0.10		**1.70**
Crop of 10,000 lbs.	**50.00**	1.00	**10.00**	4.00			**15.20**	5.00	3.00	1.00		**17.00**
Seeds, 646 lbs.	**1.48**						**5.75**					
Flesh, 9,154 lbs.	**47.44**						**8.93**					
Wood, 2,010 lbs.	**15.69**	0.67	**21.60**	3.30		0.42	**8.74**	1.75	0.64	0.61	53.42	
PRUNES, 1,000 lbs.*	**2.66**	0.13	**0.13**	0.25	0.01	0.03	**0.53**	0.10	0.19	0.01	3.03	**1.48**
Crop of 30,000 lbs.	**79.70**	3.85	**3.92**	7.45	0.38	1.04	**15.95**	2.87	5.52	0.22	120.90	**44.40**
Pits, 1,635 lbs.	**2.06**	0.40	**0.52**	1.40	0.16	0.10	**2.80**	0.46	0.68	0.02	8.60	**10.30**
Flesh, 28,365 lbs.	**77.64**	3.45	**3.40**	6.05	0.22	0.94	**13.15**	2.41	4.84	0.20	112.30	**34.10**
APRICOTS, 1,000 lbs.*	**2.83**	0.55	**0.18**	0.20	0.01	0.09	**0.71**	0.16	0.41	0.02	5.16	**2.29**
Crop of 30,000 lbs.	**84.98**	16.36	**5.45**	5.96	0.33	2.65	**21.38**	4.57	12.15	0.94	154.80	**68.70**
Pits, 1,740 lbs.	**1.36**	0.42	**0.83**	1.43	0.19	1.51	**5.36**	0.65	0.31	0.19	12.25	**15.00**
Flesh, 28,260 lbs.	**83.62**	15.94	**4.65**	4.53	0.14	1.14	**16.02**	3.92	11.84	0.75	142.55	**53.70**
ORANGES, 1,000 lbs.*	**2.11**	0.11	**0.99**	0.23	0.02	0.04	**0.53**	0.23	0.03	0.04	4.32	**1.83**
Crop of 20,000 lbs.	**42.28**	2.16	**19.72**	4.61	0.32	0.83	**10.60**	4.52	0.56	0.80	86.40	**36.60**
Seeds, 240 lbs.	**2.74**	0.10	**1.32**	0.60		0.06	**1.61**	0.36	0.08	0.04	6.90	
Flesh and rind, 19,760 lbs.	**39.54**	2.06	**18.40**	4.01		0.77	**8.99**	4.16	0.48	0.76	79.50	
Roots, percentage	**15.43**	5.15	**49.89**	6.91		1.02	**13.47**	5.78	1.75	0.72	100.12	
Stems, percentage	**11.69**	3.20	**55.13**	6.34		0.57	**17.09**	4.64	1.22	0.15	100.00	
Leaves, percentage	**16.51**	5.21	**56.38**	5.72		0.52	**3.27**	4.43	4.83	4.03	99.91	
OLIVES, 1,000 lbs.	**8.55**	0.76	**2.32**	0.54		0.14	**1.18**	0.14	80.77	0.23	94.63	**5.85**
Crop of 2,200 lbs.	**18.81**	1.68	**5.10**	1.18		0.30	**2.59**	0.30	177.72	0.50	208.18	**12.86**
Pits, 429 lbs.	**6.77**	0.57	**4.01**	0.91		0.19	**2.40**	0.29	177.63	0.48	193.25	**9.67**
Flesh, 1,771 lbs.	**12.04**	1.11	**1.09**	0.03		0.11	**0.19**	0.01	0.09	0.02	14.56	**3.19**
Leaves, 4,400 lbs.	**58.05**	2.10	**88.53**	8.48		2.72	**20.08**	9.11	0.81	0.28	190.16	**69.90**
Wood, 11,000 lbs.	**24.46**	4.31	**66.63**	6.30		4.02	**14.87**	2.00	0.59		123.18	**117.67**
ALFALFA, 1,000 lbs.	**13.49**	0.51	**22.86**	2.02		0.53	**6.43**	4.16	13.41	1.59	65.00	**12.96**
Crop of 12,000 lbs.	**161.88**	6.12	**274.32**	24.24		6.36	**77.16**	49.92	160.92	19.08	780.00	**155.52**

WHEAT, 1,000 lbs. (whole plant)	**9.15**	0.35	**2.30**	1.36	-------	0.39	**4.13**	1.44	30.52	1.65	51.26	**8.75**
Crop of 4,800 lbs. (hay)	**43.92**	1.68	**11.04**	6.52	-------	1.76	**19.80**	6.93	146.50	7.89	246.04	**42.00**
Grain, 20 bushels	**7.85**	0.14	**0.72**	2.57	-------	0.22	**11.90**	0.34	0.24	0.02	24.00	**24.00**
Straw, 3,600 lbs.	**36.07**	1.54	**10.32**	3.95	-------	1.54	**7.90**	6.59	146.26	7.87	222.04	**18.00**
SUGAR-BEETS (fresh), 1,000 lbs.	**5.38**	3.09	**3.11**	2.71	-------	0.23	**1.61**	1.12	0.62	0.86	18.73	**2.38**
Crop of 72,000 lbs.	**387.44**	222.48	**224.08**	195.60	-------	16.68	**116.16**	80.64	44.96	61.68	1349.72	**173.40**
Roots, 40,000 lbs.	**152.00**	24.00	**16.00**	24.00	-------	3.00	**36.00**	12.00	8.00	12.00	287.00	**60.40**
Tops, 32,000 lbs.	**235.44**	198.48	**208.08**	171.60	-------	13.68	**80.16**	68.64	36.96	49.68	1062.72	**113.00**
RAMIE, 1,000 lbs.*	**8.84**	1.76	**23.08**	5.90	0.12	1.80	**6.46**	1.70	24.71	1.12	75.19	**12.97**
Crop of 14.25 tons	**251.98**	50.14	**657.82**	168.27	3.57	51.43	**155.70**	48.56	704.25	51.85	2143.57	**369.70**
Leaves, 4.25 tons	**68.13**	8.99	**566.91**	114.58	1.92	38.56	**77.13**	30.86	692.71	41.56	1641.35	**206.10**
Stalk (without bark), 7.25 tons	**155.99**	33.63	**71.77**	43.68	1.45	12.16	**67.71**	14.53	7.06	2.50	410.48	**105.85**
Bark (cuticle and fiber), 2.75 tons	**27.86**	7.52	**19.14**	10.01	0.20	0.71	**10.86**	3.17	4.48	7.79	91.74	**57.75**
COTTON, 1,000 lbs.	**11.00**	4.44	**13.76**	4.28	-------	2.09	**7.03**	5.00	4.08	2.58	54.26	-------
Crop of 3,200 lbs.	**35.26**	14.21	**44.04**	13.71	-------	6.43	**22.54**	16.00	13.08	8.27	173.60	-------
Leaves, 400 lbs.	**7.99**	4.40	**15.03**	2.50	-------	2.38	**4.22**	5.84	3.58	2.75	48.69	-------
Stems, 1,200 lbs.	**9.17**	3.65	**10.58**	3.56	-------	0.75	**4.49**	1.99	1.71	2.54	38.44	-------
Seeds, 800 lbs.	**8.99**	1.15	**3.07**	4.00	-------	0.52	**9.74**	1.11	0.31	0.48	29.37	**29.20**
Burrs, 400 lbs.	**7.42**	4.59	**14.16**	3.19	-------	2.66	**3.57**	6.88	7.40	2.14	52.01	-------
Lint, 400 lbs.	**1.69**	0.42	**1.20**	0.46	-------	0.12	**0.52**	0.24	0.08	0.36	5.09	-------

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*Analysis made at the Station laboratory.

cattle-raising, or dairying, form the chief portion of farming operations, the manure produced may, for a series of years, suffice to maintain profitable production. But where, as is so largely the case in California, the maintenance of stock is only incidental, and wholly secondary, to the main industry of the growing of fruit, or some other special crop, the use of commercial fertilizers becomes unavoidable, unless such resources as accumulations of sheep-corral manure, or natural fertilizers, such as marl, greensand, etc., are available. It happens that in California, marling is, as a rule, much less effective than in the East, for the reason that the great majority of soils contain, naturally, so much lime, that marling produces little or no effect, unless, indeed, other useful substances, such as phosphate or greensand, are contained in the material used.

General Policy to be Pursued in Fertilization.—Since different culture-plants differ widely in regard to the draught made upon the soil by the portion actually marketed, it is clear that, on one and the same soil, the replacement of soil ingredients, by fertilization, should be based upon a knowledge of what is actually carried away from the soil by the annual crop, both in kind and in quantity. A solid foundation for such replacements is supplied by analyses of crops, as given in the table on pages 124–125.

Now, if it be true that a diminution of production and ultimate soil exhaustion is due to the withdrawal of the available plant-food in the soil, it follows that, if we were to replace conscientiously each year, and from the outset, precisely what the crop has taken away, as calculated from the data in the table, we should maintain production undiminished, indefinitely. The fact that when green crops are plowed-in year after year, instead of being taken away from the land, productiveness steadily increases, instead of diminishes, seems to more than demonstrate the above axiom. But, as a matter of fact, in returning the whole crop to the soil, we give back more than was taken from it; not only the ingredients which the crop has taken from the atmosphere, but also in the mineral matter taken from the soil, of which an additional amount is annually made available to the plant by the natural fallow. This leaves us, then, a certain margin which can be omitted in the replacement.

On the other hand, if we return to the soil simply such ingredients as are stated in the analyses, and *all* of these, experience shows that, on the one hand, we add a good deal that is wholly unnecessary; while on the other hand, we omit the replacement of one important ingredient, of which the soil is currently depleted (when under cultivation) by the increased action of the air resulting from tillage. This is the vegetable matter (mold, humus) which forms no part of any commercial fertilizer, and the importance of which for crop production is very great in many points of view. This burning-out of the humus is the main cause of the increased difficulty of tillage and compacting of the soil observed in orchards kept scrupulously clean of weeds, and which, therefore, receive only the very inadequate return of the annual fall of the tree leaves. It is in such cases particularly that green-manuring is first indicated, in preference to the use of any commercial fertilizer whatsoever; and should the soil refuse to produce such crop in sufficient profusion, manuring for that particular crop should take precedence of that intended to benefit the trees directly. The need of maintaining the humus-supply in orchards has been so fully recognized by many of the older orchardists in Central California, that some have advocated allowing the weeds to grow, as of old, in order to plow them under for the benefit of the soil. It is obvious, however, that as a crop of weeds may compel the farmer to cultivate at very inconvenient times, it is far better to use, for green-manuring, a definite crop which can be gotten rid of at once, at a given time. (See above, under the head of "Green-Manuring.")

Of course, the plowing-in of straw or leaves in sufficient quantity, or that of stable manure, may be made to answer the same purpose of supplementing the deficiency in humus.

Rotation.—The long-continued use of stable manure alone has been recognized long ago as frequently overloading the soil with certain ingredients, while not supplying a sufficiency of others; much depending, of course, upon the particular crops grown. The most profitable use of stable manure itself, as well as of the soil resources, with or without manure, always requires a change or rotation of crops; and in the case of field crops, the advantage of so doing is sufficiently familiar to all intelligent farmers. The need of rotation arises not only from the great differences in the nature of the ingredients withdrawn from the soil by the merchantable portion of different crops, but also, and very largely, from the differences in the depth to which the roots penetrate to gain their nourishment, as has been already explained in connection with the subject of green-manuring.

In the case of annual field crops, the only obstacle to rotation is, usually, the want of a profitable market for one or the other of the crops that are to form the succession. But in the case of orchards and vineyards, in which rotation is impracticable and therefore a one-sided use of the soil is continued for a long series of years, it clearly becomes necessary to adapt the fertilization to that special case, as expressed by the analyses given in the table above. In this case, stable manure usually does not supply the ingredients required, in proper proportion for replacement; and hence, if used, it should usually be modified by the addition of some commercial fertilizer, which makes up for any existing deficiency.

Fertilizers.—This presupposes, however, that the soil has been so long under cultivation that little or nothing can be expected to be supplied from its native store of plant-food. Obviously, such cases will at this time be wholly exceptional in California. Very few "exhausted" soils are at present to be found in this State; and the high quality (*i. e.*, the native intrinsic fertility of many of our soils) is such that the need of fertilization will, in many regions, not arise for many years.

Oddly enough, the cultivators of some of these very lands not infrequently write to the Station for advice as to the fertilizer to be used in their already exuberantly productive soils, and are quite disappointed when informed that in all probability no kind of fertilization would produce any useful effect, beyond, possibly, some (desirable or undesirable) modifications of the product. Thus, on many soils of the San Joaquin Valley, as well as on some of Southern California, the addition of even a small amount of a nitrogenous fertilizer to the soil will be apt to cause a sappy and superabundant growth of wood, and of similarly sappy, insipid fruit. On the other hand, on many of the light sandy and very gravelly soils of Southern California, the small proportion of real soil-substance contained in the sand or gravel will sometimes render the early application of fertilizers at least useful, if not absolutely necessary.

It is not easy, then, to answer definitely such questions as, "What is the best fertilizer for oranges, apricots, or prunes?" etc., if the inquirer desires at the same time to use economy in his purchase. Unless something is known of the original quality and present condition of the soil, we can only point to the table of analyses given above, and advise the purchase of the three ingredients usually supplied in fertilizers, in about the proportion there indicated.

This, however, is a very crude use of the principles of fertilization, as is shown by the fact that in all the older countries of the world, where rational agriculture is most advanced, such indiscriminate use of "complete fertilizers," outside of stable manure, has been almost abandoned, and the individual ingredients are bought by the farmer in accordance with the probable requirements of his particular case; thus saving a large proportion of wholly unnecessary outlay. A large part of the work of European experiment stations is directed especially to the accomplishment of this saving of useless outlay, which, in view of the narrow margin between profit and loss in the agriculture of to-day, oftentimes turns the balance one way or the other. Against this practical proof of the necessity and practicability of such discrimination, all the admonitions to use "complete fertilizers" *in all cases* are unavailing; for the reduction of the expense of production is now assuredly the only way out of the slough of despond in which the farmer finds himself.

As a matter of fact, this very question of the ascertainment of the special needs of each field has formed one of the greatest problems of agricultural science from its beginning. In Europe, the established rotations, based upon long experience in badly worn or exhausted soils, serves largely as a guide, and dressings of potash salts, phosphates, and nitrogenous fertilizers, applied singly to the successive crops known to be specially in need of them, after a certain course of rotation, are matters of everyday practice. The same condition of things is taking effect in the Eastern States, wherever the soils have become worn; "mixed fertilizers" are being more and more discarded for the "simples" intended to produce a definite effect in connection with a definite crop, thus reducing the expense of purchase to a minimum.

But in the fresh and mostly intrinsically highly fertile soils of California, the need of supplying *all* the three prominent fertilizer ingredients, at this time, must be wholly exceptional; and since the great distance from the market for most of our products renders economy of production as imperative as in older countries, if the industry is to be remunerative, it behooves us to scan, as closely as do the people of the older countries, the exact needs of the soils in each case.

Agricultural science has not yet succeeded in devising methods that will enable us to give a categorical answer in every case; but enough progress has been made in this direction to enable us, in a great majority of cases, to give the farmer at least a probable forecast of the needs of his particular soil, so as to relieve him from the necessity of purchase of superfluous soil ingredients.

Field "Test Plots."—An apparently easy and simple method of ascertaining the soil's immediate requirements is that of establishing "test plots," on which different fertilizers are tried with one and the same or with different crops, and inferring from the results the needs of the land. However apparently easy and conclusive, such tests afford by no means the definite information sought, unless in experienced hands, by lucky accident, and under exceptional conditions of uniformity of soil and favorable seasons. Since in all cases the effect of any and all fertilizers is contingent upon an adequate supply of moisture, heat, and other favoring, but not always controllable conditions, a failure of a certain fertilizer to produce a favorable effect will as frequently be due to the non-concurrence of the outside causes referred to, as to the inefficacy of the ingredients applied. Inequalities of soil or subsoil, slight differences in treatment unobserved by the ordinary experimenter, will frequently so mar the outcome that, if a sufficient number of check-plots be used, the results will often flatly contradict each other, and thus the results of a year's work are null. It usually, therefore, requires experiments continued during several seasons to arrive at really reliable conclusions by field-plot experiments, even in the hands of practiced experimenters. In those of the farming population at large, they so frequently miscarry as to produce serious discouragement.

Where irrigation is available, and therefore the uncertainty of seasonal moisture conditions can, with due care, be eliminated, field tests can be made much more satisfactory; yet, even then, the temperature conditions introduce an element of uncertainty that cannot be controlled. In any case, however, the tests should be made on the *largest scale* possible, and particularly in the case of trees, the rows variously fertilized should be made to cross, as nearly as possible, the inequalities of surface and of soil; that is, up and down hills, across hollows or swales, etc., so as to verify the effect of the varying conditions upon the action of the fertilizer. Again, in the weighing of the product, and its sampling for testing or analysis, it is not sufficient to include a few trees, and two or three fruits, as has frequently been done; but all must be done on a scale sufficiently large to represent a commercial average. The Experiment Station is sometimes compelled to decline spending the large amount of labor involved in examinations of such inadequate samples, since the results could only by accident represent any really valuable and reliable conclusions. Actual analysis has, in a number of instances, shown that, e. g., the differences between different oranges of one and the same trial-lot were as great, or even greater than between those of different lots submitted for examination. It thus becomes necessary to check carefully, among themselves, several lots of "unfertilized" fruit, before it is admissible to draw conclusions as to the effects of fertilizers upon them.

Very frequently, however, a close investigation of the conditions under which certain favorable or unfavorable results have been produced, will obviate the need of experiments for the express purpose. Thus, instead of attempting to produce puffy oranges by artificial means, elaborately devised to suit a particular theory, the accurate study of the conditions existing in an orchard habitually producing such fruit, would probably afford a quicker and more definite means of reaching a reliable result. But, even then it would be inadmissible to jump at the conclusion that the same cause is to be assigned in *all* cases; for usually several different causes may produce similar symptoms and results.

It is therefore extremely desirable that other means leading to definite results in a shorter time should be made available. One, and the most obvious, is to withdraw the vegetation experiments from the uncertainties and vicissitudes of the season by conducting the culture of some plant of rapid development, under the complete control of the observer, on a small scale, in-doors; or under such protection as will do away with at least the most serious uncertainties, namely, those relating to moisture and temperature. With a proper selection of soil and such care in management of the experiment as most persons habitually bestow upon their favorite *pot cultures*, very definite results can thus be obtained in the course of a few months. This mode of experimentation is now largely practiced in Germany with extremely satisfactory results as to field crops; such as out-door plot-experiments had yielded only in the course of from five to seven years. But, of course, strict attention to all details is absolutely required in order to insure satisfactory and practically available results; the idea being to test the effects of the various fertilizers under the best possible conditions. When properly carried out with representative soil samples, nothing can be more conclusive than such experiments; provided, of course, that the failure of the land to produce satisfactory results really arises from the need of fertilization, and not from unfavorable mechanical and physical conditions, such as hardpan, heavy clay, or extremely sandy subsoil, etc. It is also evident that if no fertilizer should produce a markedly beneficial effect, other causes than lack of plant-food are indicated.

It is clear, however, that in the case of deep-rooted trees, even such tests as these, made with the surface soil, will not be entirely conclusive; for in many light and sandy California soils the tree roots are not to be found at less than twelve inches depth, and it is practically impossible to include in the culture test the entire soil-column of eight to twelve feet, from which the tree may draw its supply in the orchard. Moreover, in many such cases the ordinary insoluble fertilizers may lie within the surface soil for a long time, without, in any manner, contributing to the nourishment of the tree. The conclusion of the plot-experimentor would then be that the tree is not in need of the very fertilizer that may be lacking.

Preliminary Chemical Examination of Soils.—Another mode of forecasting both the first productiveness of virgin soils and the subsequent first needs of the soil, may be based upon its chemical analysis, made according to definite and uniform methods, and therefore capable, in connection with actual experience in cultivation, of definite interpretation. Despite all that has been said against the reliability of the conclusions to be drawn from chemical soil-analysis, thus interpreted, the proof that in the case of virgin soils its indications are of the most definite and unquestionable value, is overwhelming. A virgin soil showing high percentages of plant-food under any rational method of analysis, invariably proves fertile unless extraneous physical conditions stand in the way. The reverse, however, is by no means true; under special conditions soils showing even very small percentages of plant-food may prove both highly and lastingly productive; so that the interpretation of such work cannot be based upon mere figures or percentages, but upon a consideration of all the circumstances of each case.

It stands to reason, as a mere common-sense inference, that the natural process of soil-formation from rock debris will, in a soil naturally rich in plant-food ingredients, put more of these in available form for plant use than when but a small supply is present. Hence, when analysis shows any *one* ingredient to be greatly in excess of the others, the natural inference is that it will be the *last* needing to be artificially supplied; while an extremely small proportion of some of the essential ingredients will lead to the opposite conclusion, viz., that under ordinary conditions of culture it will be the *first* to be exhausted, and therefore will *first* need to be given to the land in the form of some fertilizer.

These common-sense presumptions are so valuable in saving the farmer the waste of "carrying coal to Newcastle," that it should require more than the mere belittling to cause them to be lightly discarded. It is often alleged that because European and (until lately) Eastern authors have not favored soil analysis as a means of determining the needs of soils, the subject may be summarily dismissed. The fact is, however, that neither European nor Eastern chemists have in their work dealt with virgin, or at least with very fresh soils, but have attempted to solve the most difficult and complex problem of determining the needs of badly worn or exhausted soils, in the first instance. It is no wonder that they failed to come to any definite results; and yet, the latest work done on this subject in Germany, by Professor Liebscher, of Göttingen, shows results from soil analysis so closely representing those of a seven-years' course of plot-experimentation, as to justify his statement that had these analyses been made and considered in the first place, "the work of plot-experimentation might at least have been greatly shortened, and the results measurably foreseen." Similar conclusions have been reached as the result of the work of Bernard Dyer on the soils of the well-known experiment station of Sir J. B. Lawes, of Rothamstead, England, by the use of a process designed to imitate as closely as possible the actual action of the root-sap of plants on the soil.

The additional light thrown on the estimation of the requirements of soils as to nitrogen, outlined in another portion of this report, puts us in possession of the means of approaching very closely to a reasonably safe forecast of the present needs, even of soils long cultivated; while as regards those still in their original condition or but recently taken into cultivation, such forecasts can be made with great definiteness, as the result of the comparison of thousands of analyses with actual farming experience.

Soil Map of California.—With a view to these facts, it has been the plan of this Station, from the first beginning, to obtain as soon as possible the data for a general soil map of the State, based upon field surveys and the examination in the laboratory of samples properly taken, to such extent as might be feasible or necessary. Thus far no State aid has been received for this purpose. Until quite recently, whatever knowledge we possess of the soils of the State of California has been derived either from explorations under the auspices of the S. P. R. R. Company, or from surveys made in connection with United States census, or in the interest of private parties; or, finally, from samples sent by persons desirous of having them examined. Within the last few years the travels made by members of the Station staff, in connection with Farmers' Institutes, have been utilized for the purpose of increasing our knowledge of the local soil-conditions of the regions visited; and by plotting on a map the various data so collected, we have gradually obtained a reasonably full knowledge of the soil-conditions in the more thickly settled portions of the State. It is needless to say that the progress thus made is slow and unsatisfactory, in comparison with the systematic work of an agricultural survey; but it has, nevertheless, become possible to generalize upon the data so obtained, in connection with the examination of the samples in the laboratory, and thus gain an insight into at least the more important divisions of our soils, so far as to enable us to give farmers in the older-settled portions advice in regard to the treatment of their lands. These results are on record in the several reports of the College of Agriculture and Experiment Station.

While in a State of the enormous extent of California the regional and local variations are so many that rules without exceptions cannot often be given, yet, owing to the peculiar geological and surface conformation and climatic conditions, there is really more uniformity than would ordinarily be looked for within nearly ten degrees of latitude. Thus, the San Joaquin Valley, the Sacramento Valley, and the Sierra foothills exhibit, each within itself, a marked degree of uniformity of soil-conditions, with only such variations as can be defined with comparative ease. The same is true of the valley of Southern California, from Los Angeles to Redlands, and of the high valleys to southward.

General Conclusions.—Some of the general conclusions thus gained may be thus formulated:

1. Apart from the regions of abundant rainfall in the higher Sierra foothills and in Northern California, and a few local exceptions, all the soils of the State contain as much *lime* as is useful in soils. In almost all cases, a considerable excess of the carbonate is present, so as to insure the absence of acidity, even in lowlands where it would be expected to occur.

2. The same is almost as generally true as regards *potash:* the amounts present are, in the great majority of cases, so far in excess of the average found in the soils of Europe and of the East, that the experience of those countries cannot serve as a guide in considering the requirements of our soils. Throughout the valley lands proper of the Great Valley, as well as in that of Southern California and in the valleys of the Coast Ranges as far north as Mendocino, the soil-water carries such large amounts of potash salts (in the alkali lands often as much as one thousand pounds per acre) that to add more in fertilization would be sheer folly. While in the uplands adjacent, the drainage toward the valleys prevents such accumulation, the fact that such drainage water carries the same salts is easily verified, and is apparent from examination of the stream waters as well. It is therefore reasonable to conclude that in the great majority of California soils, potash will be the *last* one of the three ingredients, usually supplied in fertilizers, that need be purchased by the farmer.

It should be added that the same rules as regards lime and potash hold good of the greater part of the region lying between the Pacific and the Rocky Mountains, excepting the humid coast belt of Oregon and Washington; the cause being the universal one, that in all regions of deficient rainfall, the lime and potash that in the rainy countries are currently washed out into the country drainage, are partially or wholly retained in the soils.

3. No such rule, however, applies to *phosphoric acid*, because of its difficult solubility under ordinary soil-conditions. Its presence in greater or less amounts depends entirely upon the kind of rocks from which the soil is derived. It happens that in California most of the rocks—and, therefore, the soils derived from them—are *poor* in phosphates, contrary to what happens in eastern Washington and Montana. Hence, phosphates are among the first ingredients to become deficient in California soils; as has been amply proved by actual experience of farmers, in whose hands superphosphates and phosphatic guanos have become the favorite fertilizers from the first. Exceptions occur in the case of "black alkali" soils, in which soluble phosphates frequently circulate just as do the potash salts.

4. As regards *nitrogen*, the most costly of all the ingredients usually supplied in fertilizers, its average *total* amount in the soils of the arid or irrigation regions is apparently less than is usually the case in the countries of summer rains. On the other hand, the conditions for rendering it available to plants are much more favorable, and the chances of waste by washing-out very much less, save in case of excessive irrigation. So far as our observations go, it is likely to become deficient next in order to phosphoric acid under normal conditions, and should be supplied whenever the superphosphates fail to produce satisfactory results. In alkali soils, however, it occurs so constantly and abundantly in the form of saltpeter as to be in excess at times; in these, therefore, the use of nitrogenous fertilizers will, as a rule, be useless, at least for a number of years. A striking example of this state of things occurs in the case of the Chino Ranch, as shown in the preceding paper (see page 79). It will be seen that on the experimental plot, situated amid the beet-fields near the town of Chino, the average content of Chile saltpeter (nitrate of soda) per acre is about one thousand pounds, being from six to seven times as much as is usually supplied in dressings of this important fertilizer; while in some of the plots as much as four times that amount, or two tons per acre, has been found, actually rendering the land unsuitable for the culture of most crops. It is certainly not likely, therefore, that nitrogen will be among the first ingredients to be exhausted in this land, or that it would be a paying investment to supply to them complete fertilizers containing nitrogen costing from 15 to 17 cents per pound. The same state of things obtains, to a large extent, in the San Bernardino Valley, and in the San Joaquin Valley as far north as the Merced River, not only with respect to saltpeter, but also with respect to soluble salts of potash. How long this natural supply will hold out under cultivation is not easy to foresee; but surely, so long as they are known to exist already, it is folly to think of supplying them at heavy cost.

The one ingredient of which a surplus is rarely found, especially in the soluble condition, is phosphoric acid; and to supply it in an efficacious, easily soluble form is usually the most probable remedy indicated, when deficiency of plant-food makes itself felt in this State.

On this subject some highly important researches, somewhat surprising, but most conclusive in their results, have, within the last three years, been made in Germany.* It has been established beyond question that the favorable effects of even the most finely ground bonemeal, as heretofore observed, are almost wholly due to the animal matter or nitrogen contained in bones, and that its use to supply known deficiencies of phosphoric acid is wholly unprofitable and unwarranted by the returns, considered as interest on the investment.

Bonemeal of various grades of fineness, raw or steamed, has heretofore been sold at a price based upon the commercial valuation of both nitrogen and phosphoric acid, with only a slight reduction upon the full value of soluble or fully available phosphoric acid as supplied in superphosphates. It now seems that a farmer cannot afford to pay for anything more than the nitrogen value of bonemeal, say about $12 per ton, instead of $28 or $30, which has heretofore been the current price. Under such a reduction the manufacturer cannot afford to make bonemeal at all; and thus it becomes necessary, from both points of view, that bonemeal should, prior to sale as a fertilizer, be first converted into the fully available form by treatment with enough sulphuric acid to form, not necessarily superphosphates as ordinarily understood, but that intermediate compound which requires only about half as much acid and yet, according to the same investigators, possesses the full value of soluble phosphoric acid. While this will increase somewhat the cost to both the manufacturer and the consumer, it is evidently the only reasonable way in which this valuable by-product can be made fully available for agricultural use.

In the meantime, it is advisable that farmers requiring phosphoric acid as a fertilizer should expend their money for the purchase of superphosphates at the higher price, rather than for the inefficacious form in which it exists in bonemeal.

The same, of course, holds true of the natural phosphates or phosphorites, sometimes sold in commerce under the name of floats, and not uncommonly used as "fillers" in compound fertilizers. Even the finest "floats" cannot be more efficacious than fine bonemeal; the coarse phosphorite is worth little more than so much sand.

A marked exception to this rule, however, occurs in the case of the "Patapsco" phosphates of Maryland, which have been shown to exist naturally in the intermediate "dicalcic" form mentioned above, and to possess the full fertilizing efficacy of bones treated with sulphuric acid. As yet, however, these lately discovered phosphate deposits have not been so far developed as to be generally available.

The same is unfortunately true, as yet, in the United States, of the cheapest source of supply of phosphoric acid, now generally used in Europe, viz., the "Thomas," or phosphate iron-slag. It is to be hoped that in future, American iron manufacturers will avail themselves of the chance of producing this valuable by-product, at the same time with first-class metal from ores now generally rejected; benefiting both themselves and the agricultural community.

In conclusion, I cannot but reiterate my recommendation to farmers to adapt their mode and methods of fertilization to the special requirements of their crops and lands by the use of the separate ingredients of commercial fertilizers, rather than by the purchase of ready-made mixtures indiscriminately recommended by the manufacturers. To do so will involve the use of brain work in the study of the principles of fertilization, but is certain to result in a material saving of outlay for the purchase of unnecessary ingredients; even more than in Europe or in the East, where the lands have been subjected to all-around depletion by centuries of culture. In our fresh, or relatively fresh, lands a surplus of one or more ingredients over those existing in the smallest amount, may almost always be expected; and to increase the surplus by further addition of the same ingredients is sheer waste. Sound economy requires that only what is needful should be used; but those in doubt, and having a surplus of this world's goods, and an indisposition to use their brains, may of course continue in the beaten track.

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* On the effects of bonemeal as a source of phosphoric acid to crops (Ueber die Phosphorsaeurewirkung der Knochenmehle), by Professors Maercker and Steffek, of the Halle Experiment Station. Paul Parey, publisher, Berlin, 1895.

ANALYSES OF FERTILIZERS, GYPSUM, ETC.

Poudrette fertilizer; sent by Thomas Lewis, of Sacramento. An analysis resulted as follows:

	Per Cent.	
Nitrogen—As ready-formed ammonia	.10	
As nitrates (calculated as ammonia)	.11	
As organic nitrogen (calculated as ammonia)	.62	
Total		.83
Phosphoric acid—Available	1.79	
Insoluble	.96	
Total		2.75
Potash		.40

On comparing this with an analysis of good stable manure, it is seen that they are about equal, weight for weight.

Fertilizer; sent by Fred C. Miles, of Penryn, Placer County. An analysis gave the following results:

		Per Cent.
Nitrogen—As free ammonia		none.
As nitrates		none.
As organic nitrogen (calculated as ammonia)		4.23
Phosphoric acid—Available	8.68	
Insoluble	15.16	
Total		23.84
Potash		.21

This is a very good fertilizer, and, according to customary valuation, worth $25 to $28.

Potash sulphate, from D. L. Wilbur, of Riverside. The sample contains 92 per cent of the sulphate, which is considerably above the guaranteed amount.

Bird guano, from George Frost, of Riverside. A preliminary examination shows this to be of good, perhaps high, quality, containing an abundance of easily soluble phosphoric acid and considerable ammonia.

Fertilizer, from Wm. Huelster, of Ontario. A preliminary or partial analysis of the sample shows it to contain about one third gypsum; the rest is apparently sheep manure. Of course, corral manure always contains more or less of sand and dirt, and this constitutes probably about 20 to 25 per cent of the sample.

Ostrich manure; sent by Edwin Cawston, of Norwalk, Los Angeles County. For comparison with manure from other fowls, and with that of animals, the following table is given:

ANALYSES OF VARIOUS MANURES. (Calculated to 20 per cent moisture.)

	Ostrich.	Fowls.	Ducks.	Geese.	Horses.	Cows.
Moisture	20.00	20.00	20.00	20.00	20.00	20.00
Organic matter	37.25	46.40	56.42	46.64	63.27	62.07
Ash ingredients	42.75	33.60	23.58	33.36	16.73	17.93
Nitrogen total	1.30	2.90	1.82	1.91	1.69	1.93
Phosphoric acid	2.15	3.20	2.55	1.88	1.35	.47
Potash (K_2O)	1.00	1.55	1.12	3.28	1.68	1.65

The ostrich manure thus seems to be the poorest of bird manures, but approaches in its several parts most nearly to that of ducks. It is poorer in nitrogen than any of the manures of the above table; is poorer in phosphoric acid than most of the bird manures, but richer than that of geese, horses, and cows; while in potash it is poorer than any of the manures given above.

Guano; sent by Wm. Lichtenberg & Co., of San Francisco. The putty-like substance, said to come from a South Pacific island, contains:

	Per Cent.
Moisture	27.39
Total phosphoric acid, partly dicalcic	29.92

This is a phosphate fertilizer of high grade, and contains nothing else of value.

Fertilizer; sent by Charles S. Hardy, of San Diego. The material is found to be chiefly gypsum, mixed with some organic odorous matter. Under the microscope are seen fat globules and some animal tissue, thus indicating the presence of tankage.

Guano, from an island in Southern California; sent by Dr. G. Schulenberg, of San Diego. The analysis gave the following results:

		Per Cent.
Total moisture		8.08
Nitrogen—As free ammonia	.14	
As nitrates	none	
As organic nitrogen (calculated as ammonia)	8.32	
Total		8.46
Phosphoric acid—Available	6.61	
Insoluble	6.24	
Total		12.85

Lime refuse, from the Chino Beet-Sugar Factory; sent by the Chino Ranch Company, Chino, San Bernardino County. The substance as it stands contains:

	Per Cent.
Moisture	27.71
Total nitrogen (calculated as ammonia)	0.26
Total phosphoric acid	2.08

According to the analysis, the material is worth about $3 per ton, on the basis of the current valuations of nitrogen and phosphoric acid. Doubtless, when fresh it contains more moisture and more nitrogen. If transportation can be afforded, the material would doubtless benefit the heavier lands of the region.

Paris green (two samples); sent by Henry Brainard, of San José. The examination resulted as follows:

	No. 1.	No. 2.
Arsenious acid (in combination)	55.96	54.08

A microscopic examination fails to show the presence of free arsenic in either of the samples, and the results show that they are of the regular composition and pure, being entirely within the regulation limits.

Gypsum (commercial samples); sent by Miss L. E. Hatch, of Fresno.

	No. 1.	No. 2.
Gypsum	39.04	53.47
Calcium carbonate, etc	53.96	18.93
Insoluble matter (sand, etc.)	7.00	27.60
	100.00	100.00

Each of these samples is low in its percentage of gypsum, and high in inert matter; No. 1 being especially so. Each is too poor for shipping or hauling to any distance, and No. 1 almost so much so as to make its application to alkali land too expensive for the advantages to be derived.

Gypsum (commercial sample); sent from the San Joaquin Valley Experiment Station, Tulare. The sample contained 70.1 per cent of gypsum, which places it about on a par with ordinary grades offered in the market.

Gypsum (commercial sample); sent by John P. Burk, of San José, and said to be from the mine in San Benito County, near King City.

	Per Cent.
Gypsum	77.49
Other soluble matter	6.14
Sand and insoluble matter	16.37
	100.00

This sample is a little better than that ordinarily found on the market, but does not equal the highest grades, which reach over 90 per cent of pure gypsum.

Gypsum, from Coalinga, Fresno County; sent by Louis Einstein, of Fresno.

	Per Cent.
Gypsum	75.87
Other soluble matter	8.08
Sand and insoluble matter	16.05
	100.00

This is a good average gypsum as furnished by the mines of the State.

Gypsum, from the Long Hill Mine; sent by U. M. Voice, of Cadogan, Fresno County.

	Per Cent.
Gypsum	73.28
Other soluble matter	5.52
Sand and insoluble matter	21.20
	100.00

This sample is of the same grade as that put on the market from other mines of that part of the State.

Gypsum, from the Long Hill Mine, Cadogan, Fresno County; sent by J. F. Cadogan, of Cadogan. Analysis made by P. W. Tompkins, a student in the Agricultural laboratory.

	Per Cent.
Gypsum	89.00
Calcium carbonate	1.89
Other soluble matter	1.43
Sand and insoluble matter	7.68
	100.00

This sample is of a much higher grade than that usually put on the market by the mines of that region.

"*Gypsum*," from south side of Panoche Creek, and from the top of the ledge. The sample was in the form of large white lumps, mixed with a darker powder; sent by W. K. Brown, Hollister. It gave the following results as obtained by student P. W. Tompkins:

	Powder.	Rock and Powder.
Gypsum	3.50	2.35
Calcium carbonate, etc.	15.19	20.29
Sand and insoluble residue	81.31	77.36
	100.00	100.00

The samples are both too low in gypsum-content to be of any value.

Gypsum, from the mine 20 miles south of Huron, Fresno County; sent by C. M. Davis, of Selma. Analysis by P. W. Tompkins, a student in the Agricultural Laboratory:

	Per Cent.
Gypsum	98.35
Sand and insoluble residue	.10
Other soluble matter	1.55
	100.00

The sample is very pure, and far above the grade usually offered in the market.

Gypsum; sent from Traver, Tulare County, by H. Hurst.

	Per Cent.
Gypsum	58.26
Calcium carbonate, etc.	6.87
Sand and other insoluble matter	34.87
	100.00

The sample is much below the grade usually offered in the market. It contains nearly 35 per cent of inert matter, which must be taken into account when applied to the land, as well as in the price paid. It is too poor to ship or haul to any distance.

Gypsum, from the Rockford Mine, near Fowler; sent by W. M. Voice. Sample No. 1 was taken in March, and analyzed by P. W. Tompkins; No. 2 was taken in May, 1895.

	No. 1.	No. 2.
Gypsum	76.98	85.98
Calcium carbonate	4.00	7.50
Insoluble matter	19.02	6.52
	100.00	100.00

Sample No. 1 is as good in grade as is usually found in the market; while No. 2 is superior to those ordinarily offered for sale.

Gypsum (two samples); sent from Tarpey, Fresno County, by John Birney, to ascertain their relative value, No. 1 being offered for sale at a lower price.

	No. 1.	No. 2.
Gypsum	65.01	61.70
Calcium carbonate	7.18	4.03
Insoluble matter (sand, etc.)	27.81	34.27
	100.00	100.00

Though each of the samples falls below the ordinary grade, it is seen at a glance that No. 1 is the better of the two, containing, as it does, more than 3 per cent more of gypsum and less of inert matter. The large amount of the latter in each should be taken into account in gauging the price and the quantity applied to land.

Gypsum, from the Paoli Gypsum Mine, 14 miles west of Mendota, Fresno County; sent by the Paoli Gypsum Company.

	Per Cent.
Gypsum	93.73
Calcium carbonate	.50
Insoluble matter (sand, etc)	5.77
	100.00

This is an excellent grade of gypsum, and far above that usually found in the market.

Gypsum, from J. H. McKnight, of South Riverside. The sample was granular, white, and soft to the feel. It was very pure.

Gypsum, (three samples); sent by J. H. Henry, President Gypsum Land Plaster Company, San José.

	No. 1.	No. 3.
Gypsum	63.4	76.8
Carbonate of lime	8.7	10.3
Insoluble matter (sand, etc.)	7.9	12.9
Totals	100.0	100.0

These are about an average in grade with the commercial article of gypsum, though No. 1 is somewhat lower than the majority.

Gypsum; sent by L. S. Sumner, of Santa Margarita. The samples were all pure gypsum.

Gypsum; sent by J. Wells, of San Francisco. This was a very fair grade, containing 76 per cent of gypsum.

VI. FOODS, FODDER-STUFFS, SUGAR BEETS, ETC.

INVESTIGATION OF FOOD-MATERIALS.

By M. E. Jaffa.

The great interest that has been taken in the subject of cattle-feeding, and the constant demands which have been made on this Station during the past year, have rendered it advisable to reprint from Bulletin No. 100, of this Station, some of the principles of, and terms used, in rational or scientific cattle-feeding.

Objects of Feeding.—It is well known that the young animal body requires food to supply the material necessary for its growth. But beyond this, and continuing during and past the growing stage, there is a constant wearing out and breaking down of all the tissues of the body, and this loss must be supplied in order to keep the animal in a normal, healthy condition. Not only must the wornout tissue be replaced, but the material used, as food, in producing the energy necessary for carrying on all voluntary and involuntary functions, must also be supplied. An animal which is working hard in the plow is using up a great deal of fatty tissue as well as muscle; but the animal which is doing nothing, that is, making no voluntary exertion, experiences a loss of tissue through the constant production of heat necessary for the maintenance of the normal body temperature, and also for the performance of all the involuntary functions of the body. Hence, we might summarize the objects of feeding as follows:

1. To build up and maintain the body in its normal condition;
2. To serve as fuel-supply, to be consumed in the body, thereby producing heat to keep it warm, or the energy (muscular or otherwise) necessary for the performance of work;
3. To be stored for future use.

Composition of Foods.—In order to see how these objects may best be carried out, we must understand the composition of these tissues that need rebuilding, and also the composition of the various foodstuffs at our command. Viewing them side by side, for the purpose of better comparison, a general analysis shows each to consist of the same four main ingredients—water, mineral matters, nitrogenous and non-nitrogenous material.

Water constitutes about two thirds of the weight of the body, entering into the composition of all its tissues and fluids. As it does not form nearly so large a proportion of the ordinary ration fed to stock, we can readily understand the necessity of its forming a separate part of the animal's food.

The *mineral matters* comprise about 5 per cent of the body weight, and have important functions to perform, such as entering into the formation of the teeth and bones, regulating the density of the blood and other fluids of the body, as the juices of the stomach, etc. When estimating food-values the mineral or inorganic ingredients are generally omitted, not on account of any lack of importance of that portion of the food, but for the reason that nearly all foodstuffs, no matter of what description, contain a sufficient amount of these substances, which are mainly lime, potash, and phosphoric acid, with varying amounts of sodium, iron, magnesia, sulphuric and hydrochloric acids, silica, etc.

The *nitrogenous matters* of the body, of which the major part are called proteids, the only ones that contain nitrogen, are found mostly in the muscle, gelatinous part of the bones and tendons, brain nerves, and internal organs; in short, all the working machinery of the body is composed principally of this important material. Similarly, in the foods, the main part of all the nitrogenous material is termed protein, signifying, by its Greek derivation, to take first place. Another name for the proteids is albuminoids. This important ingredient of the food is derived from the white of egg, the myosin of lean meat, gluten of wheat, casein of milk, the gelatinous part of the bones and tendons, etc. Besides the albuminoids, there are other nitrogenous matters, chief among which is the class known as amides, which are found to a greater or less extent in all foods, more particularly those of vegetable origin.

"In vegetation the amides appear as intermediate stages between the mineral or inorganic matter, in the shape of ammonia salts and the organic constituents, or albuminoids. They are, on the one hand, formed in the growing plant from the ammonia salts by a constructive process, and from them, or by their aid, probably the albuminoids are built up. On the other hand, in the animal body they are the stages through which the elements of the albuminoids pass in their reversion to purely mineral matter. In germinating seeds and developing buds the amides probably combine both these offices; in being first formed in the germ from the albuminoids in the seeds, entering the young plant or shoot, and in being reconstructed into albuminoids. Their free solubility in water, and their ability to penetrate moist membranes, adapt them for this movement. They temporarily accumulate in the seedlings and buds, but disappear to a great extent as the plant matures, albuminoids taking their places; in which transformation they require the aid of the carbohydrates." (Johnson.)

The amide percentage of the total nitrogen contained in foods varies from less than 1 per cent in some meals, up to as much as 40 per cent in some of the green fodders; and in some varieties of beets used as feeding material, as much as 50 per cent of the total nitrogen is non-albuminoid. The amides are not considered as valuable as the albuminoids in their direct nutritive effect; but they are, similarly to the carbohydrates, conservers of the albuminoids.

The albuminoids in the different food-materials are estimated from the nitrogen by multiplying the figure for the latter by 6.25; nitrogen being 16 per cent of the albuminoids. In England the factor used is 6.33. The nitrogenous compounds of the food are generally, for the above reasons, reported as *crude protein*.

The necessity of the albuminoids, or protein, in the daily food of an animal depends not only upon its important relation to such tissues as bone, muscle, blood, nerves, tendons, etc., but also upon the fact that, so far as we know, no albuminoids or protein matter is formed in the body, except by the transformation of similar substances presented to it from external sources. It cannot be obtained by conversion of any other material.

The protein can be changed into fats, and thus may serve as a fuel for the body, but *fats* cannot replace *protein.* Because the protein, or flesh-forming ingredients, *can* serve as fuel, and in certain cases take the place of fats and carbohydrates, it would be extremely unwise and uneconomical to so use them, as it would always be done at a far greater cost.

The *non-nitrogenous* part of the body is principally fat, the substance which is consumed in the production of heat and energy. The source of this element in foodstuffs is comprised in all those portions which are free from nitrogen. They are divided into two main classes—the *carbohydrates* and *fats*—and are identical with those found in the body, with the exception of starch and sugar, which are never found as such (to any extent) in the healthy body. The carbohydrates are sugar, gums, and woody fiber; the latter, in the statement of analyses of foods, is reported separately, while the remainder of the above are, in order to conform to the general usage, classed together under the head of "nitrogen-free extract." The gums play only a secondary part as regards the nutritive value of the food. The carbohydrates are first changed into fats, and then used as fuel; though it must be remembered that for the purpose of heat, fat is worth 2.25 times as much as carbohydrates (that is, 1 pound of fat is equivalent, when used as fuel, to 2.25 pounds of starchy matter). When there is a deficient amount of these elements in the food, the fat of the body is drawn upon.

The fat, as might be supposed, varies in amount more than any other substance of the animal body. It seldom falls below 6, or rises above 30 per cent. If the supply is cut off the surplus fat stored up in the body is drawn upon to keep the animal machinery going, and if this continues the protein is converted into fat and used as such. Thus, by having a proper proportion of fat in the food of the stock, not only is the fat of the body protected, but indirectly, also, the protein of the muscle and blood, which is most important.

The term fat includes the butter of milk, the fat of meats, oil of seeds, wax of plants, etc. Its amount is determined by treating the perfectly dried substance with ether, the extract thus resulting being designated as "crude fat." As might be supposed, these ether extracts have different nutritive values—the fat from the green fodder being of less value than that from the meals and seeds. Some authorities, in estimating the nutritive effect of food, give to all the crude fats the same significance. The *use of fat* is mainly as a fuel supply to the animal body, although it may form fatty tissue but *not muscle.*

Digestibility of Foods.—The chemical composition, alone, of the different food-materials is not of much value to the farmer or dairyman, if he does not know how much of each nutrient (the name given to the nutritive parts of the food—protein, fat, carbohydrates, and mineral matters) of the feeding-stuff in question is digestible, or useful to the animal. Most of the experiments in this line have been made in Germany, although some of the Eastern States are now carrying on this kind of investigation.

In all foods there is always a certain portion of each nutrient, whether it be protein, fat, or carbohydrate, which is not digested or assimilated, but passes through the body, and is valuable only as manure. In order to ascertain how much of each food is not digested, the material is weighed and chemically analyzed before consumption, and the weight and composition of the animal excrement are also determined. The difference of the two analyses is taken as the quantity digested or assimilated. The results so obtained are termed *digestion coefficients*, and are only approximate, but, in the present state of such researches, the best data available. For each food the digestion coefficient may vary considerably—the more concentrated the food, the higher, as a rule, will be the digestion coefficient. For instance, while about 57 per cent of the protein is digestible in oat hay, 78 is the figure for wheat middlings or bran, and in some of the peas and beans we find as much as 88 per cent of this highly important ingredient.

To illustrate the above statements: In every 100 pounds of alfalfa hay (average of three analyses) there are 17.60 pounds of crude protein, 3.08 pounds of crude fat, 39.31 pounds of nitrogen-free extract, and 22.63 pounds of crude fiber. For this hay, according to the latest investigations, it has been found that of the protein it contains about 70 per cent is digestible; of the fat, 51 per cent; of the crude fiber, 46 per cent; and about 68 per cent of the nitrogen-free extract can be digested. Hence, in 100 pounds of the alfalfa hay there would be 12.32 pounds of digestible protein, 1.57 pounds of digestible fat, 26.73 pounds of digestible nitrogen-free extract, or starchy material, and 10.40 pounds of digestible fiber.

Nutritive Ratio.—The different feeding-stuffs vary very much in their composition; peas and beans, and the concentrated food in general, contain large amounts of protein, or muscle-forming ingredients, and very little of the non-nitrogenous materials; others, like the potato, corn, etc., have much starchy matter combined with small quantities of albuminoids; and, again, as in the case of the vegetables as a whole, we have small amounts of both carbohydrates, or fat-producers, and nitrogenous, or muscle-formers.

The proportion of these two important elements of the cattle foods is termed the *nutritive ratio*; in other words, the latter is the ratio of the digestible protein to the sum of all the remaining nutrients in the food. In estimating this sum, the figure denoting the amount of fat is multiplied by 2.25, because it has been ascertained, by experiment, as before stated, that about 2.25 times as much heat is developed by the consumption of a pound of fat, as by the same quantity of sugar or starch. This product is added to the weight of the carbohydrate, and the sum divided by the figure for the protein, the quotient being the nutritive ratio.

To illustrate this: Let us take, again, alfalfa hay, which contains, as previously noted, 12.32 per cent of digestible protein, 1.57 per cent of fat, 26.73 per cent of digestible nitrogen-free extract, and 10.40 per cent of digestible fiber. The fat percentage (1.57), multiplied by 2.25, amounts to 3.53; this added to the figure for the fiber and carbohydrates, 37.13, equals 40.66, which, divided by 12.32, the per cent of protein, gives 3.3. Hence, the nutritive ratio is 1:3.3; in other words, there is in alfalfa hay 1 part of protein, or nitrogenous matter, to 3.3 parts of non-nitrogenous, or starchy material. The ratio is "wide," and termed a carbonaceous one when the amount of protein to the remaining ingredients is small, as seen above. A "narrow," or nitrogenous ratio, is one where the reverse is the case; that is, the amount of protein is considerable compared to that of the carbohydrates, as in the example just given.

Potential Energy.—The measure of food as regards its fuel value is made in terms of "potential energy," the unit of which is the *calorie*, or the amount of heat necessary to raise the temperature of a kilogram of water 1° Centigrade, or one pound of water 4° Fahrenheit. Instead of this unit we may use a unit of mechanical energy, the foot-ton, which is the force that would lift one ton one foot, one calorie being equal to about 1.53 foot-tons.

Recent experiments have been made with animals in the respiratory apparatus to learn the proportions in which the several classes of nutrients replace each other as fuel for the body. At the same time experiments have been made with the calorimeter to determine the heat of combustion of the same materials. The results so obtained agree very well with those from the direct experiment with the respiratory apparatus, and they also proved that the different nutrients replaced each other according to their ascertained heats of combustion.

Professor Rubner found, in experiments made in the physiological laboratory at Munich, the qualities of materials which were equal to 100 of fat to be as follows:

Nutritive Substances, Water-Free.	As determined by direct experiment with Animals.	As determined by Calorimeter.
Myosin	225	213
Lean meat	243	235
Starch	232	229
Cane sugar	234	235
Grape sugar	256	235

Taking the ordinary food-materials as they come, the following general estimate has been made for the average amount of energy in one gram of each of the classes of nutrients:

Potential Energy in Nutrients of Food.

	Calories.	Foot-Tons.
In one gram protein	4.1	6.3
In one gram fats	9.3	14.2
In one gram carbohydrates	4.1	6.3

These figures mean that when a gram of fat is consumed, be it fat of the food or body fat, it will, if its potential energy be all transformed into heat, yield enough to warm 9.3 kilograms of water 1° Centigrade; or if it be transformed into mechanical energy, such as the muscles use to do their work, it will furnish as much as would raise one ton 14.2 feet, or 14.2 tons one foot. The potential energy of the protein or carbohydrates is less than one half that of the fat. These figures, as stated by Professor Atwater, are not absolutely accurate, and may be revised by future research in the subject.

The potential energy is very simply calculated by the use of the above figures. The amount digestible of each of the nutrients is ascertained thus: For each gram of protein so found there will be 4.1 calories of potential energy; similarly for carbohydrates, and for each gram of fat, 9.3 calories. A much more convenient mode of calculating the potential energy is to estimate it for the pound of the food used. This is done by supposing each per cent of each nutrient to represent 0.01 of a pound, which is equivalent to 4.53 grams. Hence, in 0.01 pound of protein or carbohydrates there will be 18.6 calories (4.53×4.1); 0.01 pound of fat will yield 42.2 calories (4.53×9.3).

Let us apply these figures to alfalfa hay, which contains 12.32 per cent of digestible protein, 1.57 per cent of fat, 26.73 per cent of nitrogen-free extract, and 10.40 per cent of fiber. The potential energy, expressed in calories, for the protein in one pound, would be 229 (12.32 × 18.6). For the carbohydrates (the sum of the fiber and nitrogen-free extract), 690 calories (37.13 × 18.6). The fat in one pound would yield 66 calories. Hence, the total fuel value, or potential energy, in one pound of the alfalfa hay amounts to 985 calories.

COMPOSITION OF THE FEEDING-STUFFS.

In the table below are given the results of the analyses of the different cattle-foods, which I have analyzed since the publication of our last report, and also, for comparison, the analyses of some of the feeding-stuffs already reported. The table contains both the percentage composition and the amount digestible in 100 pounds:

TABLE 1.—COMPOSITION OF CALIFORNIA FODDERS.

	Original Substance.										Potential Energy in One Pound (Calories)	Nutritive Ratio
	Percentage Composition.						Amount Digestible in 100 Pounds.					
	Moisture.	Pure Ash.	Crude Protein.	Crude Fiber.	Nitrogen-Free Extract.	Crude Fat.	Crude Protein.	Crude Fat.	Crude Fiber.	Nitrogen-Free Extract.		
Green Fodders.												
1. Flat pea (Lathyrus sylvestris)*	63.48	3.18	8.18	9.76	13.77	1.63	6.23	.98	5.27	8.94	422	1: 2.4
2. Snail clover (Medicago turbinata)	81.25	2.07	2.85	4.66	8.41	.76	2.00	.60	2.33	5.89	197	1: 4.7
3. Modiola decumbens, Kern County alkali soil	80.00	2.87	2.72	3.24	10.56	.61	1.90	.49	1.62	7.39	224	1: 5.3
4. Alfileria (Erodium cicutarium)	80.00	1.72	2.83	4.72	9.81	.92	2.13	.73	2.12	6.38	228	1: 4.6
5. Sacaline (Polygonum saghalinense), leaves	82.28	1.21	5.02	2.41	8.09	.99	3.78	.79	1.08	5.26	222	1: 2.1
6. Sacaline (Polygonum saghalinense), stalks	82.09	.90	1.61	7.17	7.89	.34	.82	.17	3.58	3.95	162	1: 9.6
7. Alfalfa (Medicago sativa), Dutton's Landing	80.00	1.72	4.94	4.70	7.90	.74	3.71	.58	2.12	5.14	224	1: 2.3
8. Australian saltbush (Atriplex semibaccatum)	78.03	4.58	2.75	3.75	10.41	.48	2.09	.29	2.02	6.76	214	1: 4.5
Hays.												
9. Flat pea*	10.00	7.83	20.16	24.05	33.94	4.02	15.32	2.41	13.94	22.06	1,070	1: 2.7
10. Oat hay (first quality)*	10.38	6.75	8.31	23.85	47.91	2.80	4.74	1.34	13.83	29.70	954	1: 9.9
11. Oat hay (second quality)*	9.80	7.24	6.57	25.75	48.54	2.10	3.74	1.00	14.93	30.09	949	1: 12.7
12. Oat hay, Tulare	10.39	7.04	6.83	23.86	48.54	3.34	3.89	2.00	10.73	31.56	943	1: 12.0
13. Wheat hay, Danville, Contra Costa County	11.67	6.95	6.48	18.72	54.33	1.85	3.69	1.11	8.42	35.11	929	1: 12.5
14. Wheat hay, University grounds (cut in blossom)	6.60	5.55	5.77	25.00	55.38	1.70	3.20	1.02	11.25	35.10	966	1: 14.7
15. Wheat hay, University grounds (seed in milk)	8.78	5.51	5.51	24.67	53.96	1.57	3.14	.94	11.10	35.07	957	1: 15.3
16. Wheat hay, University grounds (seed in dough)	9.08	5.65	6.56	23.22	55.54	1.95	3.74	1.17	10.48	34.80	980	1: 12.8
17. Wheat hay, University grounds (seed in stiff dough)	7.99	5.16	5.51	21.79	57.55	2.00	3.14	1.20	9.81	37.40	987	1: 15.8
18. Common barley hay, Tulare	6.44	7.15	11.11	22.55	50.37	2.38	6.33	1.43	10.14	35.42	1,014	1: 7.7
19. Beardless barley hay, Tulare	10.67	5.67	8.05	21.03	51.80	2.78	4.59	1.67	9.46	33.67	958	1: 10.2
20. Alfalfa, San Joaquin*	11.92	5.89	14.10	21.25	44.27	2.57	9.87	1.31	9.77	30.10	980	1: 4.3
21. Alfalfa, Tulare	10.02	5.73	16.71	25.72	38.43	3.39	11.70	1.73	11.83	26.13	996	1: 3.5
22. Alfalfa, Dutton's Landing	10.92	7.67	22.01	20.93	35.20	3.27	15.41	1.67	9.65	23.94	981	1: 2.4
23. Alfalfa, average	10.95	6.43	17.60	22.63	39.31	3.08	12.32	1.57	10.40	26.73	986	1; 3.4

24. Snail clover	10.15	9.92	13.65	22.34	40.29	3.65	9.56	1.83	11.17	28.20	987	1: 4.5
25. Wild yellow clover	9.50	5.39	15.58	30.28	35.25	4.00	10.13	2.40	13.62	22.99	965	1: 4.1
26. Burr clover*	11.25	6.91	10.50	26.19	44.92	2.23	5.99	1.29	11.79	29.70	942	1: 7.1
27. Bokhara clover	9.01	7.04	13.35	22.14	45.26	3.20	8.68	1.92	9.96	29.42	976	1: 5.0
28. Wild hay (Eleocharis palustris)*	11.55	7.66	5.69	22.27	51.18	2.65	2.89	1.06	11.36	31.37	900	1: 15.7
29. Wild hay (Atropis Californica)*	10.10	6.82	5.30	27.34	48.44	2.00	2.65	.80	13.94	30.03	901	1: 17.3
30. Australian saltbush hay	7.05	19.37	11.64	15.88	44.05	2.01	8.75	1.21	8.58	29.63	925	1: 4.5
Grain.												
31. Wheat (average of 5 analyses)*	11.35	1.74	11.31	2.60	71.09	2.08	9.05	.87	2.34	61.85	1,399	1: 7.3
By-Products, Etc.												
32. Wheat bran (average of 4 analyses)*	12.42	5.61	13.44	8.52	56.41	3.74	10.48	2.58	2.13	43.43	1,151	1: 5.2
33. Wheat screenings (average)*	11.16	2.94	10.06	5.48	67.63	2.72	5.36	1.47	3.02	48.67	1,123	1: 10.4
34. Wheat middlings (average)*	11.82	3.57	16.39	4.86	58.78	4.58	12.77	3.16	1.21	45.26	1,246	1: 4.0
35. Rice bran	10.55	6.64	14.96	4.85	50.20	12.80	10.73	10.64	3.68	38.15	1,426	1: 5.9
36. Cocoanut oil-cake meal	14.68	4.27	19.16	8.55	42.81	10.53	15.71	9.58	1.71	30.21	1,290	1: 3.3
37. Cotton-seed oil-cake meal	9.85	4.86	47.25	3.19	22.64	12.21	41.11	10.99	1.47	13.92	1,514	1: 1.2
38. Linseed oil-cake meal*	9.35	5.22	29.75	6.23	31.20	18.25	24.39	16.61	1.25	22.77	1,670	1: 2.7
39. Sugar-beet pulp, fresh, Alvarado	90.00	.31	.98	1.94	6.69	.08	.88	.08	1.75	6.02	164	1: 8.9
40. Sugar-beet pulp, dry, Alvarado	10.88	2.73	8.75	17.30	59.59	.75	7.88	.75	15.57	53.54	1,464	1: 8.9
41. Sugar-beet pulp, fresh, Chino	90.00	.42	1.25	2.05	6.14	.14	1.13	.13	1.84	5.53	164	1: 6.7
42. Sugar-beet pulp, dry, Chino	3.63	4.06	12.08	19.72	59.19	1.32	10.87	1.19	17.75	53.27	1,573	1: 6.7
43. Sugar-beet pulp, fresh, Watsonville	90.00	.34	1.21	2.35	5.92	.18	1.09	.16	2.11	5.33	165	1: 7.1
44. Sugar-beet pulp, dry, Watsonville	4.74	3.22	11.50	22.40	56.43	1.71	10.35	1.54	20.16	50.79	1,577	1: 7.1

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* Published in previous reports.

Green Fodders.—Of the green fodders mentioned in the table, the flat pea is the richest in nutritive value, but its usefulness is limited to certain parts of the State which are adapted to its growth. A description of this plant will be found in this report, under "Seed Distribution."

The snail clover, No. 2 in the table, is a valuable fodder; having about the same composition as alfileria, No. 4. It is also fully described elsewhere in this report.

Modiola decumbens, No. 3, is an important feeding-stuff, because, while it is quite rich in nutrients, it is well adapted to alkali and waste lands. It contains 2.73 per cent of protein, or flesh-forming ingredients, which is nearly the same as alfileria or snail clover. (See "Seed Distribution.")

Sacaline, Nos. 5 and 6. The analyses of the leaves of this plant prove it to be exceedingly rich as a cattle-food. Its aluminoid per cent is 5.02, and fat per cent is 0.99, being only exceeded by that of the flat pea. The leaves, when this plant is mature, contains by far the major part of the nutritive ingredients found in the plant, as a whole. The stalk is a very poor food. (See "Seed Distribution.")

The Australian saltbush is one of the best forage plants for alkali lands that has come to our notice.

Alfalfa, No. 7, from Dutton's Landing, is the richest in protein of any specimens of this feeding-stuff that have been examined at this Station. The protein-content being so high, a duplicate determination was made, which yielded the same result as that at first obtained.

Hays.—An examination of the table shows that the alfalfa hay from Dutton's Landing, No. 22, is the richest of all, containing 22 per cent of protein, or flesh-forming ingredient; this is about three times that found in the best oat hay or wheat hay, twice the quantity given for the best barley, and one and a half times that noted for snail clover.

The alfalfa from Tulare also contains high percentages of nutrients. The two new analyses of alfalfa made this season increased materially the average for this most excellent forage plant. This average, as it now stands, is ahead of that given for the Eastern article, as is indicated by the following tabular statement:

	No. of Analyses.	Moisture.	Ash.	Crude Protein.	Crude Fiber.	Crude Fat.	Nitrogen-Free Extract.
Alfalfa (California) ------	3	10.95	6.43	17.60	22.63	3.08	39.31
Alfalfa (Eastern) --------	21	8.44	7.44	14.20	25.01	2.15	42.68

An important addition to the analyses of California fodders is that of wheat hay, not only because we wish to know the composition of the home article, but also for the reason that hay is not generally made from the wheat plant in the Eastern States.

An examination of the results given in the table for this feeding-stuff shows that in protein-contents it is about equal to oat hay; but contains considerably more starchy matter than either oat or barley hay, rendering it a good feed for fattening purposes.

The common barley hay differs but slightly in composition from oat hay. But hay from beardless barley is much richer in protein than either the best oat, wheat, or common barley hay, as is seen by comparing the per cents: 11.11 for beardless barley, about 8 for oat and common barley, and 6½ for wheat.

The clovers all show high percentages of the different nutrients.

By-Products.—With respect to the wheat by-products in general, it may be said that they are very valuable as concentrated foods, and of course are only used as such.

Rice bran and the oil-cake meals are rich food-materials, but must be used sparingly, on account of the taste which the latter contain.

One of the most important feeding-stuffs represented in the table is the sugar-beet pulp. Three samples were obtained: one each from Chino, Watsonville, and Alvarado. In the fresh state, they contain about 90 per cent of water; consequently, in every 100 pounds there will be only 10 pounds of available food-material. The analysis of the wet pulp shows that it is not very rich in nutrients, but this deficiency is made up by their being in such a digestible and easily assimilable form. It is relished by all kinds of stock, and eagerly sought after by all feeders. The amount used per day per animal by some of the feeders is about 90 pounds; this is fed in conjunction with about 12 pounds of alfalfa hay.

Sugar-beet pulp has one great advantage over many other fodders, in that it silos itself. If placed in a ditch or trench the top will decompose somewhat, but at the same time forms a seal, as it were, for the remainder of the pulp, which will remain sweet.

While no average of the analyses of the different feeding-stuffs produced elsewhere are given, it may be stated that, so far as examined (where representative samples have been used), the California products compare very favorably with those of the Eastern States.

FEEDING STANDARDS AND RATIONS.

After having ascertained the composition of the feeding-stuffs and their digestion coefficients, the next step is to know just how much the animals require per day to keep them in a normal and healthy condition. These amounts are called rations. As might be supposed, this differs with the purpose for which the animal is kept, whether it is growing, being fattened, used for work, or making milk. A horse that is working hard all day in the plow certainly requires more food than one that is doing nothing at all; although, even in that case, the animal needs some of each of the nutrients in order to perform the functions of the body. As stated by Professor Allen: "The cow requires not only materials for her maintenance, but must also have protein, fat, and carbohydrates to make milk from. The milk contains water, fat, protein (casein or curd), sugar, and ash, and these are all made from the constituents of the food. If insufficient protein, fat, and carbohydrates are contained in the food given her, the cow supplies the deficiency for a time by drawing on her own body, and gradually shrinks in quantity and quality of milk, or both. The stingy feeder cheats himself as well as the cow. She suffers from hunger, although her belly is full of swale hay, but she also becomes poor and does not yield the milk and butter she should. Her milk glands are a wonderful machine, but they cannot make milk casein out of carbohydrates in coarse, unappetizing, indigestible swale hay or sawdust, any more than the farmer himself can make butter from skim milk. She must not only have a generous supply of good food, but it must contain a sufficient amount of the nutrients needed for making milk. Until this fact is understood and appreciated, successful, profitable dairying is out of the question. The cow must be regarded as a living machine. She takes the raw materials given her in the form of food, and works them over into milk. If the supply of proper materials is small, the output will be small. The cow that will not repay generous feeding should be disposed of at once, and one bought that will. There are certain inbred *characteristics* which even liberal feeding cannot overcome."

The standards commonly in use in this country are the ones set down by the German investigators in this subject, notably, Dr. E. Wolff, by whom the following table has been worked out:

TABLE 2.—FEEDING-STANDARDS.

(Pounds per Day per 1,000 Pounds Live Weight.)

	Total Organic or Dry Matter	Protein	Carbohydrates	Fat	Nutritive Ratio.	Fuel Value or Potential Energy (Calories)
Horse at light work	21.0	1.5	9.5	.40	1:7	22,148
Horse at average work	22.5	1.8	11.2	.68	1:7	27,050
Horse at hard work	25.5	2.8	13.4	.80	1:5.5	33,503
Oxen, fattening—1st period	27.0	2.5	15.0	.50	1:6.5	34,660
Oxen, fattening—2d period	26.0	3.0	14.8	.70	1:5.5	36,062
Oxen, fattening—3d period	25.0	2.7	14.8	.60	1:6.0	35,082
Milch cows	24.0	2.5	12.5	.40	1:5.4	29,588
Sheep, wool-producing (coarser breeds)	20.0	1.2	10.3	.20	1:9.0	22,234
Sheep, wool-producing (finer breeds)	22.5	1.5	11.4	.25	1:8.0	25,049
Sheep, fattening—1st period	26.0	3.0	15.2	.50	1:5.5	35,962
Sheep, fattening—2d period	25.0	3.5	14.4	.60	1:4.5	35,826
Swine, fattening—1st period	36.0	5.0	27.5		1:5.5	--------
Swine, fattening—2d period	31.0	4.0	24.0		1:6.0	--------
Swine, fattening—3d period	23.5	2.7	17.5		1:6.5	--------

Besides the necessary amount of nutrients, the food must have a certain bulk furnished by the coarse fodder, which helps digestion, and tends to keep the animal satisfied and healthy. The measure of the bulk is the amount of dry matter, or organic matter, in the ration, as shown by the figures 24 for the ration of a milch cow; of course, this may vary without any serious results. The kind of food a dairyman would give, depends on what is the main crop or by-product in his section, how near he is to market, and the cost of the different concentrated foods at his command.

Grave errors may arise by following too closely the standards and rations set down by chemical research alone, without taking into account the local circumstances, and the individual needs of the animals, as well as the variation of the feeding-stuffs themselves; yet, without any knowledge of the composition of the substance fed, the farmer is not only in the dark as to the benefit to be derived from the food, but is also ignorant of the actual amounts necessary; thus, at times, wasting considerable and valuable material.

Rations.—From the figures given in Table 2, rations can be calculated by having the analyses of the different foods before one. In order to facilitate matters in this direction, a table has been made up from data given in Table 1. It shows the total weight of dry matter, and amounts of digestible nutrients in different weights of the feeding-stuffs analyzed.

TABLE 3.—SHOWING TOTAL DRY MATTER AND AMOUNTS OF DIGESTIBLE NUTRIENTS IN DIFFERENT WEIGHTS OF FEEDING-STUFFS.

	Feedstuffs.		Digestible Matter.			Fuel Value (Calories).
	Weight.	Total Dry Matter.	Protein.	Carbo-hydrates.	Fat.	
Green Fodders.	lbs.	lbs.	lbs.	lbs.	lbs.	
1. Lathyrus Sylvestris (flat pea)	10	3.65	.62	1.42	.10	4,220
	2,000	730.00	124.60	284.20	19.60	844,000
2. Snail clover	10	1.87	.20	.82	.06	1,970
	2,000	374.00	40.00	164.00	12.00	394,000
3. Modiola decumbens	10	2.00	.19	.90	.05	2,240
	2,000	400.00	38.00	180.00	9.60	448,000
4. Alfileria	10	2.00	.21	.85	.07	2,280
	2,000	400.00	42.60	170.00	14.60	456,000
5. Sacaline, leaves	10	1.77	.38	.63	.08	2,220
	2,000	354.00	75.60	126.80	15.80	444,000
6. Sacaline, stalks	10	1.80	.08	.75	.02	1,620
	2,000	360.00	16.40	150.60	3.40	324,000
7. Alfalfa	10	2.00	.37	.73	.06	2,240
	2,000	400.00	74.20	145.20	11.60	448,000
8. Australian saltbush	10	2.19	.21	.88	.03	2,140
	2,000	438.00	41.80	175.60	5.80	428,000
Hays.						
9. Snail clover	10	8.98	.96	3.90	.18	9,870
	2,000	1,796.00	191.20	787.40	36.60	1,974,000
10. Burr clover	10	8.92	.60	3.97	.13	9,420
	2,000	1,784.00	119.80	795.80	25.80	1,884,000
11. Wild yellow clover	10	9.05	1.01	3.66	.24	9,650
	2,000	1,810.00	202.60	732.20	48.00	1,930,000
12. Bokhara clover	10	9.10	.87	3.94	.19	9,760
	2,000	1,820.00	173.60	787.60	38.40	1,952,000
13. Australian saltbush	10	9.25	.88	3.82	.12	9,250
	2,000	1,850.00	175.00	764.20	242.00	1,850,000
14. Alfalfa (average)	10	8.92	1.22	3.62	.17	9,820
	2,000	1,784.00	243.00	724.80	34.80	1,964,000
15. Oat hay (first quality)	10	8.96	.47	4.35	.14	9,540
	2,000	1,792.00	94.80	870.60	26.80	1,908,000
16. Wheat hay (average)	10	8.83	.37	4.35	.11	9,290
	2,000	1,766.00	73.80	870.60	22.20	1,858,000
17. Common barley hay	10	9.30	.63	4.56	.14	10,140
	2,000	1,860.00	126.60	911.20	28.60	2,028,000
18. Beardless barley	10	8.93	.46	4.30	.17	9,580
	2,000	1,786.00	91.80	860.60	33.40	1,916,000
19. Wild hay (Eleocharis Pal.)	10	8.84	.29	4.31	.11	9,000
	2,000	1,768.00	57.80	861.80	21.20	1,800,000

TABLE 3—Continued.

	Feedstuffs.		Digestible Matter.			Fuel Value (Calories).
	Weight.	Total Dry Matter.	Protein.	Carbo-hydrates.	Fat.	
Concentrated Foods and By-Products.	lbs.	lbs.	lbs.	lbs.	lbs.	
20. Wheat (grain)	2	1.77	.18	1.28	.02	2,798
	10	8.86	.91	6.42	.09	13,990
	2,000	1,772.00	181.00	1,283.80	17.40	2,798,000
21. Wheat middlings	2	1.75	.22	.97	.05	2,524
	10	8.76	1.12	4.86	.28	12,620
	2,000	1,752.00	225.20	972.40	56.80	2,524,000
22. Wheat screenings	2	1.77	.10	1.03	.03	2,246
	10	8.85	.54	5.17	.15	11,230
	2,000	1,770.00	107.20	1,033.00	29.40	2,246,000
23. Wheat bran	2	1.75	.21	.91	.05	2,302
	10	8.76	1.05	4.55	.26	11,510
	2,000	1,752.00	209.60	911.20	51.60	2,302,000
24. Cocoanut meal	2	1.71	.31	.64	.19	2,580
	10	8.53	1.57	3.19	.96	12,900
	2,000	1,706.00	314.20	638.40	191.60	2,580,000
25. Cotton-seed meal	2	1.80	.80	.31	.22	3,028
	10	9.02	4.11	1.54	1.10	15,140
	2,000	1,804.00	822.00	307.80	219.80	3,028,000
26. Linseed cake meal	2	1.81	.49	.48	.33	3,340
	10	9.05	2.44	2.40	1.67	16,700
	2,000	1,810.00	487.80	480.40	333.80	3,340,000
27. Rice bran	2	1.77	.21	.84	.21	2,853
	10	8.85	1.07	4.18	1.06	14,265
	2,000	1,770.00	214.60	836.60	213.80	2,852,000
28. Beet pulp, fresh, Chino	20	2.00	.23	1.47	.03	3,280
	2,000	200.00	22.30	146.40	2.60	328,000
29. Beet pulp, dry, Chino	2	1.93	.22	1.42	.02	3,146
	10	9.65	1.09	7.10	.12	15,730
	2,000	1,928.00	217.40	1,422.40	23.80	3,146,000

The making-up of rations can be much simplified by using the fuel value of the food expressed in calories. The reason of this is that Dr. Rubner, and others, ascertained that the fats and carbohydrates can replace each other in any ration, in the proportions of 1 of fat to 2.25 parts of carbohydrates, or starchy material, without altering the food value of the ration. This being the case, we readily see why, if we know the protein, or flesh-forming ingredients, of the ration and the fuel value in calories, we greatly simplify the calculation, and at the same time vary the detailed composition of the ration. We must, however, know the amount of protein that is required; as the fuel value of a ration affords no indication of the contents of this valuable and necessary element of the ration.

To illustrate these principles, suppose we take from Table 2 the standard worked out by Dr. E. Wolff for milch cows, viz.: 24.0 pounds dry matter, containing 2.5 pounds digestible protein, 12.5 pounds digestible carbohydrates, with .40 pounds fat; and suppose a ration is to be made up from wheat and alfalfa hays and wheat bran. A trial can be made with 10 pounds of alfalfa, 15 pounds of wheat hay, and 5 pounds of bran. By consulting Table 3, we find the above-named weights to contain the following:

No. in Table.	Amount, in lbs.	Material.	Total Dry Matter.	Protein.	Fat.	Carbohydrates.	Fuel Value (Calories).
14	10	Alfalfa hay	8.92	1.22	.17	3.62	9,820
16	15	Wheat	13.25	.56	.17	6.53	13,935
23	5	Bran	4.38	.52	.13	2.27	5,755
	30		26.55	2.30	.47	12.42	29,510

This ration is low in protein, but the remaining ingredients are up to the standard. To remedy the defect in the above ration, the proportions of the two hays should be changed; more should be used of the alfalfa, as it is rich in protein, and less of the wheat hay, which is poor in this respect. In place of the weights just mentioned, let us take 12 pounds of alfalfa, 13 pounds of wheat hay, with the same amount of bran. We then have, proceeding as before:

No. in Table.	Amouut, in lbs.	Material.	Total Dry Matter.	Protein.	Fat.	Carbohydrates.	Fuel Value. (Calories.)
14	12	Alfalfa	10.70	1.46	.20	4.34	11,784
16	13	Wheat	11.48	.60	.14	5.65	12,877
23	5	Bran	4.86	.52	.13	2.27	5,755
	30		27.04	2.58	.47	12.26	30,416

This constitutes a ration fully up to the standard.

As another example: Oat hay, bran, middlings, and cotton-seed meal may be taken to form the ration. Calculating as for the preceding, we have the following tabular statement:

No. in Table.	Amount, in lbs.	Material.	Total Dry Matter.	Protein.	Fat.	Carbohydrates.	Fuel Value. (Calories.)
15	15	Oat hay	13.4	.71	.20	6.54	14,210
23	7	Bran	6.2	.70	.17	3.19	8,057
21	5	Middlings	4.4	.56	.14	2.43	6,310
25	1.5	Cotton-seed meal	1.4	.60	.16	.24	2,260
	28.5		25.4	2.57	.67	12.40	30,837

The above is a very good ration in all respects.

Concentrated Foods.—When the investigators in the subject of cattle-feeding began to discuss the making-up of rations, they found out that to obtain sufficient nutriment for each day, they had to use other materials than the hays, grasses, etc. Hence, the introduction of the so-called "Concentrated Foods," or those which contain more nourishment in a smaller bulk.

The stomach of the cow can contain only a certain amount of food, and if it is filled with the ordinary coarse fodders and hays, the animal will not be able to derive sufficient nutriment therefrom to keep it in a healthy condition, and the milk will decrease in quantity and deteriorate in quality. This is not a matter of theory, but is based on experience of the best dairymen all over the country.

It must not be supposed, on the other hand, that because some concentrated food is good, more would be better; such a course of action would result in the making of a greater mistake than if no such foods were used at all. A certain bulk (about 25 pounds dry matter per 1,000 pounds live weight) is absolutely necessary for a ration, in order that the digestive apparatus should work in a satisfactory manner. If only concentrated foods were given to the animal, it would soon become sick, and therefore be of no use, for the time being, to the feeder. It is the *proper porportion* of the two kinds of food that yields the best, in fact, one might say normal, results; because a first-class cow is certainly only in her normal condition when she is healthy and satisfied, and giving a fine quality of milk with corresponding quantity.

Those feeders who may contemplate using oil-cake meals as an ingredient in rations, must remember that they will have to proceed with extreme caution, and gradually increase (from a very small amount) the proportion of the meal in the ration. No animal can remain in a normal condition if the food is suddenly changed or altered; the body would suffer, and disastrous results would, in all probability, be brought about as regards the milk. Then the feeder might discard the new food entirely, thinking it to be of no value, whereas the fault was with himself in making the sudden change. A cow which has been accustomed to wheat bran as a concentrated food cannot suddenly be given oil-cake meal in place of it, and remain as she was before the introduction of the new feed. If the change made was due to the fact of the meal being cheaper, it might be another case of proving that "cheap things are sometimes dear."

It is not advisable, as a rule, even after the animals have become accustomed to the oil-cake meal, to have the latter form the entire "concentrated" element of the ration; but only a minor part of it. Bran or middlings, etc., should be used with the meals.

FOOD VALUE OF FRUITS FOR LIVE STOCK.

The use of fruits as a part of the feed for stock is exciting more attention on the part of the horticulturist every year. In almost every orchard there is some fruit which cannot be placed on the market. The chief causes for this are: (1) the "windfalls," or fruit which is generally immature; and even if first-class, would be bruised or injured to such a degree as to preclude its sale. (2) Freights may be so high, and prices so low, as to leave no profit to the grower in marketing any but the best of the crop; and sometimes even for that he receives very small returns.

The question, then, is what to do with the fruit? The idea naturally suggests itself to the orchardist to feed the fruit to cattle and hogs. But he is undecided as to its merits as a food for the animals, and, as to the comparative value of the different fruits on the one hand and the grains and various feeding-stuffs on the other. The object of this article is to throw some light on the subject, and the following tables have been prepared in a similar manner to those of cattle-foods given above. In the tables are given analyses of some of the different fruits, grains, etc., made at the State University from California-grown materials. Hays and green fodders are not represented to any extent, because, as a rule, the fruits would only be used as a substitute for the grains and meals. A short table of the ordinary cattle-foods is also given here for convenience of comparison, although these appear in the table above:

TABLE 4.—COMPOSITION OF SOME FRUITS.

	Edible Portion.										Nutritive Ratio	Fuel Value (Calories)
	Percentage Composition.							Amt. Digestible in 100 lbs.				
	Water	Ash	Protein	Fiber	Nitrogen-Free Extract	Fat	Sugar	Protein	Carbo-Hydrates †	Fat		
Apples	84.80	.50	.40	1.50	12.5	.30	--------	.30	12.80	.20	1:44.2	252
Oranges*	88.30	.41	.76	--------	--------	--------	7.10	.57	9.66	--------	1:10.9	180
Apple pomace	76.70	.50	1.40	3.90	16.2	1.30	--------	1.00	11.90	1.10	1:24.7	286
Pears	83.90	.54	.56	2.73	11.46	.79	--------	.42	12.90	.63	1:33.7	274
Plums*	78.40	.52	1.00		6.83		13.25	.75	18.40		1:24.4	355
All prunes*	80.20	.47	.85		2.37		16.11	.64	17.89		1:27.9	345
Apricots*	85.07	.48	1.04		1.48		11.93	.78	13.04		1:16.7	257
Nectarines*	82.90	.49	.63		.86		15.13	.49	15.77		1:32.2	302
Figs*	79.11	.58	1.50		3.26		15.53	1.12	17.95		1:16.0	355
Grapes*	80.12	.50	1.26		1.62		16.50	.95	17.72		1:18.6	347
Watermelons	90.25	.81	1.07		7.86		--------	.81	5.90		1: 7.3	125
Watermelons, rind	89.97	1.24	1.43	1.41	5.59	.36	--------	1.08	4.20	.28	1: 4.5	110
Watermelons, pulp and juice	92.07	.30	.76	.47	5.80	.60	--------	.57	4.58	.48	1: 9.7	116
Nutmeg melon (rind, pulp, and juice)	90.18	.66	.60	.48	7.85	.23	--------	.45	5.89	.18	1:14.0	126
Raisins*	18.95	2.24	4.50		10.11		57.60	3.38	65.18		1:19.3	1,275
Dried prunes*	25.00	1.79	3.21		70.00 †			2.42	67.80		1:27.9	1,307
Dried apricots*	25.00	2.42	5.23		67.35 †			3.92	65.46		1:16.7	1,290
Dried peaches	25.00	2.14	2.76		70.03 †			2.14	68.07		1:32.2	1,322
Dried figs*	25.00	2.08	5.40		67.52 †			4.03	64.62		1:16.0	1,278

* Analysis by Geo. E. Colby, of this Station. † Including sugar.

TABLE 5.—COMPOSITION OF SOME GRAINS AND MEALS.

	Percentage Composition.						Amount Digestible in 100 lbs.				Fuel Value in One Pound—Calories	Nutritive Ratio
	Moisture	Ash	Protein	Fiber	Nitrogen-Free Extract	Crude Fat	Protein	Fat	Nitrogen-Free Extract	Fiber		
Wheat straw	14.30	4.60	3.00	40.00	36.90	1.20	.80	.40	16.24	24.00	963	1:16.0
Oat hay (first quality)	10.38	6.75	8.31	23.85	47.91	2.80	4.74	1.34	29.70	13.83	954	1: 9.9
Alfalfa hay	10.95	6.43	17.60	22.63	39.31	3.08	12.32	1.57	26.73	10.40	986	1: 3.4
Corn	10.60	1.50	10.30	2.20	70.40	5.00	7.21	3.90	61.25	1.54	1,467	1: 9.9
Barley	10.90	2.40	12.40	2.70	69.80	1.80	9.30	1.40	62.81	1.35	1,425	1: 7.2
Oats	11.00	3.00	11.80	9.50	59.70	5.00	9.00	3.90	44.17	4.75	1,242	1: 6.4
Wheat	11.35	1.74	11.31	2.60	71.09	2.08	9.05	1.04	61.85	2.34	1,406	1: 7.3
Wheat bran	12.42	5.61	13.44	8.52	56.41	3.74	10.48	2.58	43.43	2.13	1,151	1: 5.2
Wheat midlings	11.82	3.57	16.39	4.86	58.78	4.58	12.77	3.16	45.26	1.21	1,246	1: 4.0
Cotton-seed meal	9.85	4.86	47.25	3.19	22.64	12.21	41.11	10.99	13.92	1.47	1,514	1: 1.2
Rice bran	10.55	6.64	14.96	4.85	50.20	12.80	10.73	10.64	38.15	3.68	1,426	1: 5.9
Cacoanut oil-cake meal	14.68	4.27	19.16	8.55	42.81	10.53	15.71	9.58	30.21	1.71	1,290	1: 3.3

Comparisons from the Tables.—Viewing these tables side by side, we note that the fresh fruits contain from eight to ten times as much water as do the grains and meals. Hence, equal weights of the two classes of foods could not be used with the expectation of obtaining from each the same nutritive value. This is true, even if the proportion of the nutrients were alike in fruits and grains; but this is far from being similar, as is shown by glancing at the nutritive ratio of the different materials. Among the grains and meals the ratio is much narrower, and more nitrogenous, than in the case of fruits; that is, in the fruits there is more carbohydrates, for the same amount of protein, than is noted for the grains.

The next question is, how to compare the two kinds of foods? Suppose we try on the basis of the protein or nitrogenous part of the material, and for this comparison we will take wheat on the one hand and fresh apricots on the other. The former is a good average of the grains, and the latter of the fruits. The following little table shows the respective contents of the nutrients in 10 pounds wheat, and a like quantity of apricots, edible portion, which will be about 10.6 pounds whole fruit:

	Water.	Ash.	Digestible.			Fuel Value (Calories.)	Nutritive Ratio.
			Protein.	Carbohydrates.	Fat.		
10 lbs. Wheat	1.14	.17	.91	6.42	.10	14,060	1: 7.3
10 lbs. Apricots	8.51	.05	.08	1.31	----------	2,570	1:16.7

We thus perceive that wheat contains over eleven times as much nitrogenous, or flesh-forming, ingredients as we find in fresh apricots; in other words, it would require 11 pounds of apricots to equal 1 pound of wheat. The same can be said of nearly all the other fresh fruits. Even in the case of figs, which yield, among the fresh fruits represented, the highest protein per cent, we would require 8 pounds to equal 1 pound of wheat in respect to this highly important element of the food. Hence, we might say, in general, that the grains are from eight to twelve times as rich in muscle-forming material as are the fruits.

Now we will examine the little table again, and note how the foods compare as regards the carbohydrates (sugar, etc.), or heat-producers. In this case, the comparison is not so disadvantageous to the fruits. The wheat has only about five times the contents of carbohydrates that is given for the apricots, as is shown by the figures 6.42 for wheat, and 1.31 for apricots; that is, 5.3 pounds of apricots will have as much fattening ingredients as will 1 pound of wheat.

For some of the other fresh fruits, as figs, grapes, prunes, and plums, the proportion is still more favorable—from 3 to 4 pounds only of the fruit are equivalent in carbohydrates to 1 pound of grain, whereas in the melons the corresponding figures are from 10 to 12. Dried fruits make, naturally, a far better showing, as they more nearly approach in food value the grains, meals, etc. The following tabular statement illustrates this fact:

10 pounds wheat contain .91 pounds protein and 6.42 pounds carbohydrates.
10 pounds raisins contain .34 pounds protein and 6.52 pounds carbohydrates.

It is thus seen that the carbohydrates in the two materials are almost identical, and that the protein in the wheat is less than three times the amount found in raisins, which are a fair example of dried fruits. An inspection of the figures given for the fuel value, expressed in calories, will show the capacity of the different materials for producing heat and energy; the grains and meals rating from about four to twelve times higher than the fresh fruits, while the dried fruits do not differ materially in this relation from wheat and its by-products, and cocoanut cake-meal.

The fuel-value data alone, however, is not sufficient to determine the nature of the food; that is, whether nitrogenous or starchy. We must know the protein, or flesh-forming ingredients, in addition to the fuel value, in which case we can tell the kind of material in question.

How to Use Fruit in Feeding.—It would seem, from the foregoing, that the feeder is in a dilemma. If he wishes to give the necessary amount of protein to the animal by means of most of the fresh fruits in place of grain, he will have to add two or three times the requisite quantity of fattening or heat-producing ingredients—an addition not generally sought after. On the other hand, if the carbohydrates are made the standard, then when the proper amount of this part of the food is supplied by the fruit, the protein will be lacking to a considerable extent. It appears to me that the best way out of the difficulty would be to use enough fruit to supply the fattening elements of the food, and make up the deficiency of flesh-forming material from some concentrated nitrogenous food, as cotton-seed meal or cocoanut meal. In this way the ration will be complete and more economical than if no fruit were used.

Let me illustrate: A cow (1,000 pounds weight) requires per day about 25 pounds of dry matter, containing 2.5 pounds of digestible protein, 12.5 pounds of carbohydrates, and .40 pounds of fat, with a fuel value of 30,000 calories. If we have hays, grain, and bran, a good ration would be 12 pounds of alfalfa hay, 13 pounds of wheat hay, and 5 pounds of bran. The 5 pounds of bran could be replaced by 15 pounds of fresh prunes, and the deficiency in the protein resulting from the substitution could be made up with 1 pound of cotton-seed meal; or 5 pounds of raisins could take the place of the prunes, in which case ¾ pound of cotton-seed meal would suffice for the needed amount of protein. Either of the above changes from the conventional ration would make it complete with respect to its content of digestible nutrients. But the objection might be raised, and with just cause, that the ration would prove very laxative. To obviate this, it would probably be best to use a less amount of fruit and mix it with bran or middlings, etc., to prevent "scouring" the animal. A little careful experimenting on the part of the feeder would soon settle the matter.

Equivalent Values of the Fruits, Grains, etc.—It would be almost impossible to compare the fruits and grains by means of their nutrients, because the ratios of the muscle-forming material to the fattening matter in the two kinds of food are so different. But what can be done is to compute the valuation of each on the basis of 1.7 cents per pound for the protein, 3.31 cents per pound for fat, and 0.75 cents per pound for carbohydrate. These values are averages for those given in the Eastern and Middle States, and are, therefore, for this State only approximate, but sufficiently accurate for our purpose. Table 6 is calculated from

Tables 4 and 5, with the aid of these rates. A glance at this table gives us, perhaps, a better idea of the relative values of the foods under discussion, than could be obtained in any other way.

TABLE 6.—SHOWING COMPARATIVE VALUE OF FRUITS, AND HAY, GRAINS, MEALS, ETC.

	100 Pounds Fruit Equivalent to Pounds of											
	Wheat Straw ...	Alfalfa Hay ...	Oat Hay	Corn	Barley	Oats	Wheat	Wheat Bran	Wheat Middlings	Rice Bran	Cotton-seed Meal	Cocoanut Cake Meal ....
Fresh Fruits.												
Apples	34	20	24	15	15	17	16	18	16	13	9	13
Oranges	33	19	23	14	14	16	15	17	15	12	8	12
Pears	40	23	30	17	18	20	19	20	19	15	11	15
Plums	50	30	36	22	24	25	24	26	24	20	14	20
Prunes	46	27	33	20	22	23	22	24	22	18	13	18
Apricots	40	23	29	17	18	20	19	20	19	15	11	15
Nectarines	43	26	30	19	20	22	21	23	21	17	12	17
Figs	50	30	37	23	24	26	25	27	25	20	14	20
Grapes	50	30	37	23	24	26	25	27	25	20	14	20
Watermelons	22	13	16	10	10	11	11	12	11	8	6	8
Nutmeg melons	19	11	13	8	9	9	9	10	9	7	5	7
Dried Fruits.												
Dried prunes	175	104	125	78	82	88	84	92	84	67	48	68
Dried apricots	194	115	138	86	90	97	93	102	93	74	53	76
Dried peaches	190	113	135	85	88	95	91	100	91	72	51	74
Dried figs	186	110	132	83	85	93	89	97	89	71	50	72
Raisins	216	128	153	97	100	108	103	111	103	82	59	84

We note that the least valuable of the fresh fruits mentioned in the table are the melons, 100 pounds being equal to only 6 pounds of cotton-seed meal, about 10 pounds of the grains, 5 pounds of hay, and 20 pounds of straw.

Apples and oranges are practically equal in food value, rating about 50 per cent higher than the melons, as is seen by the figures for the equivalents of 100 pounds of these fruits, viz., 24 pounds of hay, 16 pounds of grains, 13 pounds of rice bran and cocoanut meal, and 9 pounds of cotton-seed meal.

A good average of the pitted fresh fruits is represented by prunes, 100 pounds of which are equal in nutriment to 46 pounds of wheat straw, 27 pounds of alfalfa hay, 33 pounds of oat hay, 20 pounds of corn, 22 pounds of barley, 23 pounds of oats and wheat and its products, 18 pounds of rice bran and cocoanut meal, and 13 pounds of cotton-seed meal. Hence, if wheat bran costs $15 per ton, fresh prunes would be worth as a substitute $3 per ton; likewise, if cotton-seed meal is selling for $21 per ton, the prune value would be about $2.75. At the market price of oat hay, the figure for fresh prunes should be nearly $3 per ton.

The amount of nutrition found in grapes and fresh figs is identical, both rating about equal, as fodders, with the pitted fruits.

The dried fruits, as before stated, rank far above the fresh material as stock feed. This is amply proven by the table. Of the dried fruits represented in the table, raisins lead in food value; containing 1¼ to 1½ times the nutritive ingredients of alfalfa and oat hays, respectively; 100 pounds of the fruit being practically equal to the same quantity of grain, but to only 82 pounds and 59 pounds respectively of rice bran and cotton-seed meal.

Dried apricots rank slightly lower than raisins, because the latter contains less water. Apricots, however, are of equal value as a feeding-stuff with wheat bran; that is, the unsalable dried apricots are worth to the orchardist about $15 per ton for feeding purposes.

It may be a difficult question at times to decide, when prices are extremely low, which would be the better economy: To feed the fruit to cattle, or to receive whatever small returns might be offered for it in the market. In such emergencies, a short soliloquy and a little arithmetic will decide the whole matter.

When there is no market for the fruit there is sometimes nothing left to be done but to feed it to stock. Under any circumstance, when stone fruit is used as fodder for hogs, it is to be feared that when the animals crack large quantities of pits, poisoning may occur from the oil of bitter almonds and the prussic acid present in the kernels. Precaution in this direction is unnecessary for cattle and horses, as they do not crack the pits. The stones or pits can be used to great advantage as fuel in the economical management of the farm.

BUTTER AND BUTTERINE.

Two samples of butter and one of butterine were received from the State Dairy Bureau, in May, 1895, and analyzed according to the usual method, and with the following results:

	Butter.		Butterine.
	No. 1.	No. 2.	No. 3.
Specific gravity at 100° C.	.909	.898	.892
Water	19.07	12.19	9.08
Fat	77.26	83.36	85.11
Casein (curd)	.82	1.21	5.81
Ash (salt, etc.)	2.85	3.24	
Totals	100.00	100.00	100.00

A microscopical examination of the above samples shows that Nos. 1 and 2 contain only crystals of butter-fat in the ether extract, while No. 3 contains other fats in connection with some butter-fat.

The water percentage of No. 1 is much higher, and hence its fat-content is correspondingly lower than the average of these two ingredients for a first-quality butter.

GLUTEN FLOUR.

A sample of gluten flour was received from the Ralston Health Food Company. The analysis is as follows:

	Per Cent.
Moisture	12.81
Albuminoids	14.96
Carbohydrates (starch chiefly, with a little sugar and gums)	68.99
Fat	2.00
Fiber (cellulose)	.60
Ash (mineral matter)	.64
Total	100.00

The percentage of albuminoids, 14.96, in this flour is about twice that found in the best *California* white flour; and higher than the corresponding figure for whole-wheat flour. The remainder of the ingredients vary only slightly from that of ordinary flour.

SUGAR BEETS, SORGHUM, AND SUGAR CANE.

Analyses of Samples Received Previous to July 1, 1895.

By M. E. JAFFA.

Sugar beets, from Southern California Station, Pomona. Three samples were received from this station during the season of 1894–95. The samples arrived in good condition, October 9th.

The results of the assays are as follows:

	No. 1. Sample from Plot 158.	No. 2. Sample from Plot 24.	No. 3. Sample from Plot 9.
Date of planting	May 29	May 29	May 29
Date of harvesting	Oct. 6	Oct. 6	Oct. 6
Date of analysis	Oct. 11	Oct. 11	Oct. 11
Weight of beets, in grams	(4) 2090.00	(3) 1820.00	(2) 2335.00
Average	522.25	606.66	1167.50
Specific gravity of juice	1.0720	1.0710	1.0610
Solid contents by spindle	17.50	17.30	15.00
Sugar per cent	16.34	15.93	10.05
Purity coefficient	93.37	92.10	67.00
Ash per cent in juice	.75	.81	.98

Nos. 1 and 2 represent very high-grade beets in all respects; the sugar per cents and the purity coefficients being exceptionally good. No. 3 falls below the requirements of the sugar factories in its sugar per cent and purity coefficient; the low figures being no doubt due to the excessive amount of nitre in the soil. A full discussion of these beets on alkali-soil plots will be found on page 84, in the article "Growing of Sugar Beets on Alkali Soils."

Sugar beets, from Salt Lake Ranch, Sites, Colusa County; sent by Mr. Peter Peterson.

"They were planted on heavy, black soil, something like adobe, about the middle of April, 1894, which is rather late for this part of the country, where we have dry summers and no irrigation. Most of the beets were harvested several weeks ago, and what remained were small."

Two samples were received on April 10, 1895: one, consisting of large beets, gathered on the 15th of March, and the other, composed of smaller beets, harvested April 6th. The large beets were soft and flabby, while the small ones were in good condition. Both specimens showed such a low percentage of *total solids* (slightly over 10), that the separate determination of sugar seemed uncalled for.

Sugar beets, from U. S. Experiment Station, Union Island, San Joaquin County. Two varieties were received December 15, 1894, and samples from the same two were sent again on the 6th of February, 1895, all in good condition. Below are the results of the four analyses:

	Knauer's Imperial.	Dippe's Klein Wanzlebener.	Knauer's Imperial.	Dippe's Klein Wanzlebener.
Date of receipt	Dec. 15,'94.	Dec. 15,'94.	Feb. 6,'95.	Feb. 6,'95.
Date of analysis	Dec. 18,'94.	Dec. 18,'94.	Feb. 8,'95.	Feb. 8,'95.
Weight of beets, in grams	(5) 4,500	(4) 3,200	2,160	2,160
Average	900	800	540	540
Specific gravity of juice	1.0713	1.0660	1.0730	1.0682
Solid contents by spindle—per cent	17.30	16.10	17.70	16.60
Cane sugar per cent	14.39	13.56	14.22	14.08
Purity coefficient	82.60	84.22	80.34	84.79
Ash per cent in juice	.71	.62	.67	.57

The specimens, at both periods of harvesting, show good percentages of sugar and very fair purity coefficients. It is worthy of mention that there was practically no decrease, either in the per cent of sugar or in the purity coefficient, while the beets were in the ground from December to February following. The weight of the beets harvested in December approached very nearly the limit allowed by sugar factories; while those which arrived in February were of about the weight desired.

Sorghum (*Orange*), grown at Lodi, California; sample received from A. M. Hill. Specimen arrived in good condition on October 24, 1894, and was analyzed the same day.

Weight of canes, in grams	700
Specific gravity of juice	1.054
Solid contents per cent	13.45
Cane sugar per cent	6.48
Purity coefficient	48.18
Ash per cent in juice	.57

This sorghum is too poor in sugar and too low in purity to be worked for sugar.

Sorghum, grown at Lodi; sample sent by A. M. Hill. Specimen received and analyzed on October 24, 1894.

Weight of four canes, in grams	1,420
Average weight of canes, in grams	355
Specific gravity of juice	1.075
Solid contents per cent	18.20
Cane sugar per cent	12.23
Purity coefficient	67.20
Ash per cent in juice	.81

This cane contains only a fair amount of sugar, with a very low purity coefficient, which would prevent the profitable working of the material.

Sugar cane, grown on U. S. Sugar Experiment Station, Union Island, San Joaquin County, California. The sample was received in good condition on December 15, 1894, and analyzed the same day:

Weight of five canes, in grams	2,775
Average weight of canes, in grams	555
Amount of juice, in cubic centimeters	800
Specific gravity of juice	1.0370
Solid contents by spindle, per cent	9.25
Cane sugar per cent	4.20
Purity coefficient	45.40
Ash per cent in juice	.58

The extremely low figures obtained for the sugar-content and the purity coefficient would prevent the cane from being worked for sugar.

PROXIMATE ANALYSES OF SUGAR CANE, SORGHUM, ETC.

By E. W. Hilgard.

The analyses here reported were undertaken with a special object of checking the correctness of the figures given for the nitrogen of sugar cane and Egyptian corn in the tables published by Lierke, as taken from Wolff's tables. In the graphic representation made by Lierke, the demand of sugar cane for nitrogen appears greater than that of any other culture plant for the same area, and several times greater than that of the botanically closely related maize; a similarly large demand for nitrogen is, in the same tables, attributed to sorghum. Suspecting that errors of record or calculation might be responsible for these discrepancies, the examination of California-grown material was determined upon with the results given in the subjoined table, at the end of which are given, for comparison, the figures calculated from Lierke's tables.

It will be seen that the average figure found by us for cane is 3.7 times less, and that for sorghum 2.2 times less than those given by Lierke; while the figure for Millo maize is considerably below that given by Lierke for maize itself.

These differences are so great that it seems hardly possible to account for them as being caused by the nature of the material analyzed; the more, as the Javanese sugar cane (as reported from the Kagok-Tegal Experiment Station), while richer in nitrogen than the imperfectly matured cane from the California Station, agrees closely with the nitrogen-content of the mature Egyptian corn from *our* Station grounds.

It thus seems that the highly improbable figures of Lierke's tables should be replaced by those calculated from the results of more recent investigations, and that sugar cane and sorghum do not form the notable exception to the nitrogen demand of the rest of the grasses that the tables, quoted above, would lead us to suppose.

PARTIAL PROXIMATE ANALYSES OF SUGAR CANE, EGYPTIAN CORN, MAIZE, AND SORGHUM. (Figures given refer to fresh plants.)
By Geo. E. Colby.

Number	Name of Variety.	Place of Production.	Date of Analysis.	Water, Per Cent.	Organic Matter, Per Cent.	Ash (Pure), Per Cent	Silica in 100 Ash, Per Cent.	Total Nitrogen, Per Cent.	Albuminoids (N × 6.25), Per Cent
1	Sugar Cane	U. S. Sugar Station, Union Island, 12 miles N.W. of Stockton, San Joaquin County, Cal.	September, 1894	88.00	11.02	0.98	15.70	0.154	0.962
2	Sugar Cane		December, 1894	83.40	16.60		--------	0.133	0.831
3	Sugar Cane	Experiment Station, West Java, at Kagok-Tegal	1893	71.98	--------	--------	--------	0.277	--------
4	Egyptian Corn	Experiment Station Grounds, Berkeley	September, 1894	75.00	23.94	1.06	37.00	*0.271	1.690
5	Orange Sorghum	Lodi, San Joaquin County	October, 1894	74.40	25.13	0.47	40.40	0.136	0.838
6	Amber Sorghum	Lodi, San Joaquin County	October, 1894	71.00	28.43	0.57	29.20	0.161	1.006
7	White Millo Maize	Experiment Station Grounds, Berkeley	September, 1894	77.40	21.38	1.22	47.02	*0.074	0.462

*Duplicated.

Lierke's Tables.

Name of Variety.	Total Nitrogen, Per Cent.
Sugar Cane	0.52
Sorghum	0.50
Maize	0.18

ANALYSIS OF AUSTRALIAN SALTBUSH (Atriplex Semibaccatum).

By M. E. Jaffa.

(Revised from Station Bulletin, No. 105.)

According to our observation, this plant, orginally obtained from Baron von Mueller, of Melbourne, strongly commends itself as a forage plant for alkali lands in the San Joaquin Valley, and elsewhere in California. It seems to be readily eaten by stock, and can be successfully grown on alkali lands which will not sustain any other crop. As the name implies, the plant is indigenous to Australia, and on page 59 of Baron Ferd. von Mueller's "Select Extra Tropical Plants" is found the following statement:

"*Atriplex semibaccatum*, R. Brown. Extra tropic Australia—a perennial herb, very much liked by sheep (R. H. Andrews), thus considered among the best of saline herbage of the saltbush country. Mr. Will Farrer pronounces this herb as wonderful for its productiveness and its drought-resisting power." It is fully described, with illustrations elsewhere, by Professor Wickson. (See Distribution of Seeds, etc.)

Unlike most of the other saltbushes, this plant has a prostrate habit, covering the ground with a green cushion 8 to 10 inches thick. Single plants form wheel-shaped masses, with small, narrow leaves ($\frac{1}{2}$ to $\frac{3}{4}$ inch long by $\frac{1}{8}$ to $\frac{3}{16}$ wide), thickly set on numerous small, slender branches; flowers inconspicuous, but fruit (heart-shaped and about $\frac{1}{10}$ inch long) of brownish-red tint, very abundant. Plant perennial, and when cut, soon reproducing itself from the same root.

At the Experiment Station, near Tulare, the herb, or bush, has been planted, with excellent results, in some of the worst alkali spots of the Station grounds; single plants having reached a diameter of 16 feet in one season. The yield of a full cut is about 20 tons of green material, or, calculating on a basis of 75 per cent water, 5 tons of dry matter per acre. According to the data given by the foreman, Mr. Forrer, a long season would permit of two such cuts. In feeding, the saltbush has been used in conjunction with hay—about $7\frac{1}{2}$ pounds of green saltbush to $2\frac{1}{2}$ pounds of hay at one feed, or in the ratio of three to one. Sheep and hogs eat it green without the least trouble; horses and cattle soon get used to it, if fed mixed with other feed at first. It never needs any salting.

Composition.—A chemical investigation of the fresh plant, as grown at Tulare, gave the following results; analyses of other fodders are given for comparison:

TABLE 1.—Proximate Analysis of the Australian Saltbush, Compared with Some Green Fodders.

	Saltbush.	Alfalfa.	Flat Pea.	Oat Fodder.
Water	78.03	74.95	63.48	62.20
Organic matter	17.39	23.38	33.34	35.30
Mineral matter (ash)	4.58	1.67	3.18	2.50
Totals	100.00	100.00	100.00	100.00

It is thus seen that of the foods here represented, the saltbush contains the least organic matter, and the most ash and water; the ash being nearly three times that found in alfalfa, about one and a half times that given for the flat pea, and not far from twice the mineral content of oat fodder.

The moisture percentages in the Australian plant and the alfalfa are quite close, and both considerably higher than those found in the flat pea (*Lathyrus sylvestris*) and the oat fodder.

In Table 2 is given the detailed analysis of the saltbush, showing its food value:

TABLE 2.—FOOD VALUE OF SALTBUSH.

	Fresh.	*Air-dried.	†Water-free.
Moisture	78.03	7.05	----------
Albuminoids	2.75	11.64	12.53
Nitrogen-free extract	10.41	44.05	47.39
Fat	.48	2.01	2.16
Cellulose (fiber)	3.75	15.88	17.08
Ash	4.58	19.37	20.84
Totals	100.00	100.00	100.00

*"Air-dried" fodder is in the condition of ordinary hay.
†"Water-free" substance is that which has been deprived of all water by artificial heat. For explanations of all the terms used in this discussion, see page 140 of this report.

The above analyses prove that this fodder is one of considerable merit, containing high percentages of the very important constituent, the albuminoids. The contents in nitrogen-free extract (starch, sugar, gums, etc.) are about an average, while the fat is somewhat low. The mineral matter represented by the ash percentage, as before stated, is exceedingly high, being nearly one fifth the total weight of the air-dried plant.

A comparison with some typical fodders will more strongly bring out the value and importance of the Australian saltbush as a cattle-food. Table 3, below, gives these data.

An inspection of the figures indicating the *protein-content* of the different foods shows that the saltbush, containing 11.64 per cent, exceeds in this respect both the oat, with 8.31, and the barley hay, with 9.21 per cent.

Alfalfa, showing 14.10 per cent, is somewhat richer in this respect than is the saltbush, while the flat pea contains nearly double the quantity so found, as indicated by the respective figures 20.16 and 11.64.

The *fat* percentage, 2.01, in the saltbush is about four fifths of that found in the other materials, with the exception of the flat pea, which has 4.02 per cent—just double the above figure.

The figure for *nitrogen-free extract*, 44.05, does not differ materially except in the case of the flat pea, where it is only about three fourths of this amount.

Crude fiber in saltbush is present in much smaller amount, 15.88 per cent, than it is in the other fodders, the average for them being 23.89; since woody fiber is the least digestible of any part of a fodder, this is rather an advantage than otherwise.

When the amounts of *digestible nutrients* (protein, fat, starch, sugar, gums, etc.) in each food are compared, the showing for the saltbush is

TABLE 3.—SHOWING COMPOSITION OF THE SALTBUSH AND SOME OTHER FODDERS.

	Air-Dried Substance.										Potential Energy in One Pound—Calories	Nutritive Ratio
	Percentage Composition.						Amount Digestible in 100 Pounds.					
	Moisture	Pure Ash	Crude Protein	Crude Fiber	Nitrogen-free Extract	Crude Fat	Crude Protein	Crude Fat	Crude Fiber	Nitrogen-free Extract		
Australian saltbush	7.05	19.37	11.64	15.88	44.05	2.01	8.75	1.21	8.58	29.63	.925	1:4.5
Alfalfa	11.92	5.89	14.10	21.55	44.27	2.57	10.58	1.23	9.77	30.10	.990	1:4.1
Lathyrus sylvestris	10.00	7.83	20.16	24.05	33.94	4.02	15.32	2.41	13.94	22.06	1.070	1:2.7
Oat hay (Californian)	10.38	6.75	8.31	23.85	47.91	2.80	4.74	1.34	13.83	29.70	.954	1:9.9
Barley hay (Eastern)	10.25	4.44	9.21	26.14	47.49	2.47	5.25	1.19	15.16	29.44	.979	1:9.1

still more promising. The nutritive ratio (the proportion between the digestible nitrogenous and non-nitrogenous parts of the foods) for alfalfa and the saltbush are almost identical, and ahead of both oat hay and barley hay, as is seen when comparing the figures 1:4 and 1:9. The flat pea being exceptionally rich in protein, shows naturally an excellent nutritive ratio, 1:2.7.

The potential energy is slightly more in the case of the other foods than that given for the saltbush, owing to its high ash percentage.

Composition of the Ash.—The large proportion of ash in the saltbush, and the fact of the plant yielding such excellent results in some of the worst alkali spots, rendered desirable a complete examination of the ash in order to ascertain the character of the mineral ingredients taken from the soil. The results of the analysis, made by Mr. P. W. Tompkins, a student in the Agricultural laboratory, are given below:

Per cent of pure ash in air-dried substance 19.37

Analysis of the Ash.

Silica (SiO_2)	16.24
Potash (K_2O)	11.42
Soda (Na_2O)	35.39
Lime (CaO)	5.79
Magnesia (MgO)	3.23
Peroxid of iron (Fe_2O_3)	1.38
Alumina (Al_2O_3)	1.95
Br. oxid of manganese (Mn_3O_4)	.22
Phosphoric acid (P_2O_5)	2.80
Sulphuric acid (SO_3)	2.64
Chlorine (Cl)	24.33
	105.35
Excess of O due to Cl	5.35
Total	100.00

From the data here presented we see that for 100 pounds of air-dried material there are 19.37 pounds of pure ash. Assuming the water in the fresh substance at about 75 per cent, every 100 pounds of dry matter corresponds to 400 pounds of green; each *ton* of green stuff being equivalent to 500 pounds of strictly dry material, or 550 pounds of air-dried matter, containing about 110 pounds of mineral ingredients. Of this extraordinary amount of ash, nearly 40 per cent, or 44 pounds, is common salt; about 15 per cent, or 17 pounds, is of soda in other combinations, mainly in the form of carbonate of soda in the crude ash. The amount of potash, lime, and phosphoric acid is relatively small; thus rendering the saltbush excellent for "desalting," or freeing the soil from objectionable sodium compounds.

Fertilizing Value of Ash.—In the ash from a ton of the green plant there are about 11 pounds of potash and 3 pounds of phosphoric acid available as plant-food; or, estimating a crop at about 20 tons to the acre, we find about 220 pounds of potash and 60 pounds of phosphoric acid. But as potash exists in more than sufficient quantity in most of the valley soils of the State, it is only the phosphoric acid that is to be considered when regarding the fertilizing value of the ash. The advantage that would accrue to the soil by the addition of that amount of phosphoric acid would be much more than offset by the large amount of alkali salts, chief among which would be the "black alkali," or carbonate of soda, and the common salt accompanying the phosphoric acid.

In the following table is given the analysis of the ash of the saltbush and that of some other plants, for the purpose of showing the comparative amounts of mineral ingredients withdrawn from the soil by them:

TABLE 4.—SHOWING ASH COMPOSITION OF THE SALTBUSH IN COMPARISON WITH SOME OTHER PLANTS.

	Australian Saltbush.	Greasewood (Kern Co.).	Alfalfa (Eastern).	Timothy Hay (Eastern).
Silica	*16.24	11.81	9.38	35.60
Potash	11.42	18.53	23.45	28.80
Soda	35.39	39.45	1.56	2.70
Lime	5.75	1.36	44.30	9.30
Magnesia	3.23	1.09	4.68	3.60
Br. ox. of manganese	.22			
Peroxid of iron and alumina	3.33	7.06		
Phosphoric acid	2.80	3.51	8.34	10.80
Sulphuric acid	2.64	4.93	5.73	3.90
Chlorine	24.33	15.30	3.12	5.00
	105.35	103.04	100.56	99.70
Less excess of O due to Cl	5.35	3.25	.68	
Totals	100.00	99.79	99.88	
Percentage of ash in air-dried plant	19.37	12.03	5.89	6.15

* About one half of the silica is soluble in carbonate of soda solution.

It is thus seen that the ash of the saltbush approaches more nearly to the composition of the ash of the greasewood than to that of either the alfalfa or the timothy. The percentages of potash and phosphoric acid in the ash of the saltbush are both less than in any of the other plants.

But although the percentages of these two vital ingredients are somewhat low, the actual amounts contained in the ash from a single crop of the saltbush are far in excess of those found for an ordinary crop of hay.

The lime in the case of the saltbush is about four times that found in the greasewood, but a little less than one seventh of the amount noted for alfalfa, and about two thirds the quantity present in timothy hay. The most striking feature of the saltbush, as compared with the other plants, is the excessive amount of chlorine, as shown by the figures 24.33 as against 15.30 for greasewood, and 3.12 and 5.00 for alfalfa and timothy respectively. The corresponding amounts of sodium chlorid (common salt) are 38.93, 24.48, 4.99, and 8.00.

While it is true that the percentages of potash and phosphoric acid are less in the ash of the saltbush than in that of the other plants, when calculated on the same amount of ash, yet the percentage of ash being so much greater in the saltbush there will be withdrawn from the soil more potash by a ton of saltbush than by the same weight of the other cultures. Table 5 illustrates this point.

TABLE 5.—QUANTITIES OF SOIL INGREDIENTS WITHDRAWN BY VARIOUS PLANTS (AIR-DRIED).

	Total Ash.	Potash.	Phosphoric Acid.	Lime.	Nitrogen.
	lbs.	lbs.	lbs.	lbs.	lbs.
Saltbush—					
In 1,000 lbs.	193.70	21.30	5.93	11.14	18.60
Crop of 10,000 lbs.	1,937.00	213.00	59.30	111.40	186.00
Greasewood—					
In 1,000 lbs.	120.30	22.29	4.22	1.64	----------
Crop of 10,000 lbs.	1,203.00	222.90	42.20	16.40	----------
Alfalfa—					
In 1,000 lbs.	65.00	13.49	6.43	22.86	*22.50
Crop of 12,000 lbs.	780.00	161.88	77.16	274.32	225.00
Wheat (whole plant)—					
In 1,000 lbs.	51.26	9.15	4.13	2.30	8.75
Crop of 5,000 lbs.	256.30	45.75	20.65	11.50	43.75
Timothy Hay—					
In 1,000 lbs.	61.50	17.71	6.64	5.72	15.40
Crop of 5,000 lbs.	307.50	88.55	33.20	28.60	77.00

* According to latest analysis of the California fodder.

The *total ash* of a crop of saltbush, as indicated by the percentage, is more than three times that contained in one of timothy, two and a half times that removed by a crop of alfalfa, and about one and a half times greater than the figure obtained for greasewood.

Potash.—The amount of potash removed from the soil by a crop of saltbush does not differ materially from that reported for greasewood; but is *greatly* in excess of the quantity withdrawn by alfalfa, more than twice that required for timothy, and nearly five times the amount found in wheat hay.

Phosphoric Acid.—The draught upon the soil by phosphoric acid is greatest in the case of alfalfa, and least in wheat hay. The amount found in the saltbush, 59 pounds, being nearly three times that given for wheat hay, still is only about three fourths the weight of phosphoric acid required for a crop of alfalfa.

Lime.—With reference to lime it is seen that a crop of alfalfa carries away more of this ingredient than do all the remaining plants here presented, as shown by the figures 274.32 for alfalfa, and only 167.90 for the other crops combined.

Nitrogen.—The highest figure for nitrogen, 225.00, is reported for alfalfa; the saltbush containing about four fifths of this quantity.

We therefore see that while the saltbush removes from the soil an enormous amount of ash, it does not draw upon the vital ingredients of plant-food to a corresponding extent.

Amount of Alkali Salts Removed from the Soil by a Crop of Saltbush.—It is of interest to know just how much of the injurious salts of alkali soils are extracted, per acre, by an average crop of saltbush. As before stated, this plant is grown on some of the worst spots of "black alkali" at Tulare Station. An analysis of the alkali salts of one of these spots gave the following results:

	Percentage Com- position.	Pounds per 100 of Soil.
Potassium sulphate	6.13	.111
Sodium sulphate	35.97	.651
Sodium chlorid	26.79	.485
Sodium carbonate	28.12	.509
Sodium nitrate	2.99	.054
Totals	100.00	1.810

This analysis shows that the chief ingredient of the alkali is sodium sulphate, or Glauber's salt; still, sodium carbonate ("black alkali") forms nearly 30 per cent of the alkali salts, and more than one half of one per cent of the soil.

In column 1 of Table 6, below, are given the amounts, in pounds per acre, of alkali salts in the crude ash of a crop of the saltbush, estimating the yield at 5 tons (dry) per acre. In column 2 the number of pounds of the salts as they occur in the soil, assuming an acre one foot deep to weigh 4,000,000 pounds. Column 3 expresses the percentage of the total quantity in the soil, which is extracted by the saltbush:

TABLE 6.

	1. Alkali Salts in Crop of Salt- bush—Pounds per Acre.	2. Alkali Salts in Soil—Pounds per Acre.	3. Percentage of Total Salts Extracted by Saltbush.
Potassium sulphate	111.48	4,440	2.51
Sodium chlorid	777.59	26,000	2.99
Sodium carbonate	471.10	20,360	2.31
Totals	1,360.17	50,800	(Ave'age) 2.60
Total sodium salts	1,218.69	46,360	(Ave'age) 2.63

From this showing it will be noted that sodium carbonate and sodium chlorid, the two most injurious of alkali salts, are removed from the soil in no inconsiderable quantities by a single crop of the saltbush; and while it would require many years of such cropping to render such soil, containing nearly 1¾ per cent of alkali salts, fit for other cultures, yet on soils where the percentage of alkali is near the limit of injury, a few crops of the saltbush would, in all probability, bring it below the danger point.

Summary of Practical Advantages of the Saltbush.—1. It can be grown successfully on arid and alkali lands.

2. Soils where the percentages of alkali are near the limit of tolerance can, no doubt, be sensibly relieved by planting the saltbush and permanently removing each cutting from the land.

3. The yield is very large, about the same as that of alfalfa and the flat pea; but nearly, if not quite, double that of either oat, barley, or wheat hay.

4. The composition is, aside from the ash, such as to make it an excellent food for stock; it seems to be readily eaten by them.

The question still to be settled, is whether the large amount of saline ingredients will be harmless to all kinds of stock, e. g. milch cows. Assuredly, no salting will be called for, and if no purgative effects are noted, no other disadvantages need be apprehended.

VII. CALIFORNIA FRUITS, CAÑAIGRE, ETC.

ANALYSES OF FRUITS.

By George E. Colby.

ANALYSES OF CALIFORNIA ORANGES AND LEMONS.

(Received for Analysis in 1894–95.)

No. 114. *Improved Navel*, grown by A. C. Thomson, of Duarte, Los Angeles County, and received June 14, 1894. Oranges of the lot varied in size, some being large and others small; in shape, some were round, and others elongated; the rind thick, brittle, and easily separated from the flesh; flesh coarse-textured and dryish. The lot is interesting, as simply showing its condition and character after keeping several months. The acid is shown to be low, and the sugar rather above the average for the ordinary Navels, but still less, by over ½ per cent, than that shown by the Improved Navel, gathered in March, 1892, or as 12.55 as against 13.10 per cent sugar. The oranges of the lot examined June 14, 1894, were, on the average, two ounces heavier than the 1892 lot; the rind percentages, 27.2 and 27.3, are almost identical for both lots, although the earlier oranges contained less pressed pulp. Aside from the coarse and dryish flesh, the lot was well preserved.

For description and notes upon samples Nos. 115 to 125, see next article of this report, under heading of "Fertilizer Experiments."

Nos. 128 and 129, respectively *Tardive* and *Valencia Late*, grown at Experiment Station, Pomona, from young trees. The samples were large and greenish-yellow in color; the flesh rather coarse and not very sweet; acid not unpleasant.

No. 130. *Villa Franca Lemon*, from Southern California Experiment Station, Los Angeles County. The samples were uncured, and very large for the variety; the skin, very thick and heavy. As they stand, the acid is too low, not reaching other Villa Francas previously examined, by 2 or 3 per cent.

No. 131. *Seedless Limes*, grown at Porterville, Tulare County, by J. T. Bearss. The samples were nearly round in shape, with roughish, yellow-green colored skin, which was thin and tough; the flesh tender, and very juicy; the seeds only three or four, and abortive. The acid, as reported, does not give this fruit more than a very low place among this class of fruits.

No. 126. *Triumph Pomelo*, sent by W. C. Fuller, of Colton, San Bernardino County. The skin of this fruit was rather dry, and hardly as heavy as earlier lots examined here; the juice not very astringent.

No. 127. *Seedling Pomelo*, sent by W. C. Fuller, of Colton, San Bernardino County. The skin was fresher than that of the Triumph, but thicker; the juice rather more astringent. Both lots show less rind than the samples reported in 1893, and also less sugar; the acid, about the same in amount as the earlier lots show.

ADDITIONAL PROXIMATE ANALYSES OF CITRUS FRUITS. (SAMPLES SENT BY GROWERS FOR ANALYSIS.)

Number	Variety.	Place of Production.	Sender, or Grower.	Date of Receipt and Analysis.	Physical Analysis.					Proximate Analysis.			Analysis of Juice.				Whole Fruit.
					Average Weight, in grams	Rind—per cent	Pulp, Pressed—per cent	Seeds—per cent	Average Juice, in cubic centimeters	Water—per cent	Organic Matter—per cent	Ash—per cent	Solid Contents, by spindle—per cent	Total Sugars (Inversion)—per cent	Cane Sugar (Polariscope)—per cent	Citric Acid—per cent	Total Nitrogen—per cent
	Oranges.																
114	Improved Navel	Duarte	A. C. Thompson	June 14, 1894	260.0	27.20	36.30		92.0				15.20	12.55		.71	
115	Navel; fertilizer, nitrogen and phosphoric acid; *no potash;* average of two analyses	Riverside	D. L. Wilbur	March 18, 1895	267.8	31.56	30.97		97.5	85.0	14.64	.36	12.40	11.56	6.17	1.00	.109
116	Navel; fertilizer, nitrogen, phosphoric acid, and *1 lb. potash, per tree*; average of two analyses	Riverside	D. L. Wilbur	March 18, 1895	267.0	30.24	34.50		96.6	84.2	15.42	.38	13.70	12.51	6.73	1.00	.187
117	Australian Navel (No. 1); fertilizer, barnyard manure	North Pomona	F. L. Palmer	May 6, 1895	190.0	41.00	25.70		55.0				13.80	10.37		1.75	.184
118	Australian Navel (No. 2); fertilizer, none				153.0	37.80	29.30		50.0				15.15	12.22		1.90	.175
119	Australian Navel (No. 3); fertilizer, nitrate of soda				160.0	39.40	26.00		55.0				13.65	10.18		1.82	.170
120	Australian Navel (No. 4); fertilizer, superphosphate (base, bone-black)				193.0	43.20	22.20		65.0				13.80	10.31		1.82	.171
121	Australian Navel (No. 5); fertilizer, muriate of potash				205.0	38.20	30.00		58.0				14.40	12.20		1.40	.158
122	Australian Navel (No. 6); fertilizer, nitrogen and phosphoric acid				160.0	39.20	25.00		48.0				13.90	11.24		1.61	184
123	Australian Navel (No. 8); fertilizer, nitrogen and potash				208.0	34.70	26.20		70.0				13.30	10.38		1.27	.185
124	Australian Navel (No. 9); fertilizer, potash and phosphoric acid				208.0	34.80	27.40		68.0				13.30	10.10		1.20	.182
125	Australian Navel (No. 10); fertilizer, nitrogen, phosphoric acid, and potash				173.0	40.90	21.20		55.0				15.05	11.70		1.96	.183
128	Tardive	Pomona	Univ. Expt. Sta.	June 23, 1895	208.0	27.50	27.50		83.3				11.40	8.30		1.03	
129	Valencia Late	Pomona	Univ. Expt. Sta.	June 23, 1895	280.0	29.90	28.10		100.0				11.20	8.30		.98	
	Lemons.																
130	Villa Franca	Pomona	Univ. Expt. Sta.	June 23, 1895	171.0	46.20	24.50		43.3				10.00	2.50		5.47	
	Limes.																
131	Seedless (Tahiti)	Porterville	J. F. Bearss	Dec. 11, 1894	117.0	20.80	23.00		60.0				9.70	3.48		5.18	
	Pomelos.																
126	Triumph		W. C. Fuller	May 13, 1895	440.0	23.10	25.40	3.4	175.0				11.20	8.00		2.31	
127	Seedling		W. C. Fuller	May 13, 1895	430.0	30.70	29.50	3.4	138.0				10.00	6.84		2.00	

AUSTRALIAN AND WASHINGTON NAVEL ORANGES FROM TREES FERTILIZED WITH VARIOUS COMPOUNDS.

These samples were grown at North Pomona, Los Angeles County, by F. L. Palmer, and are from trees fertilized, respectively, with barnyard manure, and with various commercial fertilizers, as shown below. Fruit from trees that received no fertilization are included in the analyses, to make the comparison complete:

No. 117. *Fertilized with barnyard manure* (No. 1). The rind and "rag" were thick and heavy; the skin brittle; flesh pretty juicy, and sour to the taste.

No. 118. *Not fertilized* (No. 2). The rind was not as thick and heavy as that of No. 117; the flesh drier, but if anything more sour than that of No. 117.

No. 119. *Fertilized with nitrate of soda* (No. 3). The rind was thick; the navel heavy; flesh very coarse and sour.

No. 120. *Fertilized with superphosphate* made from bone-black (No. 4). The rind was very thick and heavy; the flesh was sour, but quite juicy.

No. 121. *Fertilized with muriate of potash.* This, seemingly, possessed the best skin and presented the best appearance of any of the lot, and was not as sour as the previous samples.

No. 122. *Fertilized with phosphoric acid and nitrogen.* The rind was rather thin and brittle, but not easily separated from the flesh; the juice was sour.

No. 123. *Fertilized with nitrogen and potash.* The skin was quite thick, but separated easily from the flesh; the juice was not as sour as that of the others, but high for a Navel orange.

No. 124. *Fertilized with potash and phosphoric acid.* The skin was brittle and heavy; the flesh was "mushy."

No. 125. *Fertilized with nitrogen, phosphoric acid, and potash.* The skin was thick and heavy; the juice was very sour.

The results at large forcibly illustrate the infelicity of entangling any experiment or problem to be solved by complicating the conditions from the outset, as appears to have been done in this case in soils cultivated but a relatively short time. We must, first of all, know what is the effect of single elements before we use compounds. I should hesitate to conclude, from a single experiment, that, as is here indicated, superphosphates alone tend to produce a thick rind; or that barnyard manure and nitrate of soda produce the same effect as nitrate of soda, bone-black, and the combination of nitrogen and potash, or potash and phosphoric acid, in reducing the amount of sugar below that of the unfertilized fruit. It is trying to solve too many problems at once, upon limited premises, because of accidental differences in trees. We do not, therefore, feel like drawing any definite conclusion from the record of the table on page 174.

But experiment No. 121, with muriate of potash, does seem to corroborate the experience at Riverside, that the potash tends to increase the sugar-content more than the barnyard manure, although not above the amount found in the unfertilized fruit. No. 123 seems to show that the favorable effect of the potash, in increasing sugar, is neutralized by the addition of nitrogen. But the same would hold true of a combination of potash and phosphoric acid, as shown in No. 124. We would, therefore, come to the odd conclusion, that while potash alone increases sugar,

ANALYSES OF AUSTRALIAN AND WASHINGTON NAVEL ORANGES, VARIOUSLY FERTILIZED.

Number	Name of Fertilizer Used in Experiment.	Date of Receipt and Analysis.	Physical Analysis.				Analysis of Juice.			Nitrogen in Fresh Fruit—per cent
			Average Weight, in grams	Rind—per cent	Pulp, Pressed—per cent	Average Juice, in cubic centimeters	Solid Contents, by Spindle—per cent	Total Sugars (Inversion)—per cent	Citric Acid—per cent	
117	Barnyard manure	May 6, 1895	190	41.0	25.7	55	13.80	10.37	1.75	.184
118	Not fertilized	May 6, 1895	153	37.8	29.3	50	15.15	12.22	1.96	.175
119	Nitrate of soda	May 6, 1895	160	39.4	26.0	55	13.65	10.18	1.82	.170
120	Superphosphate (from bone-black)	May 6, 1895	193	43.2	22.2	65	13.80	10.31	1.82	.171
121	Muriate of potash	May 6, 1895	205	38.2	30.0	58	14.40	12.20	1.40	.158
122	Nitrogen and phosphoric acid	May 6, 1895	160	39.2	25.0	48	13.90	11.24	1.51	.184
123	Nitrogen and potash	May 6, 1895	208	34.7	26.2	70	13.30	10.38	1.27	.182
124	Potash and phosphoric acid	May 6, 1895	208	34.8	27.4	68	13.30	10.10	1.20	.185
125	Nitrogen, phosphoric acid, and potash	May 6, 1895	173	40.9	21.2	55	15.05	11.79	1.96	.183

Notes on the above Analyses—Maxima and Minima.

Largest sample, No. 123, nitrogen and potash, and No. 124, potash and phosphoric acid; *smallest* sample, No. 118, non-fertilized.

Rind, maximum, No. 120, superphosphate; *minimum*, No. 123, nitrogen and potash, and No. 124, potash and phosphoric acid.

Juice, maximum, No. 123, nitrogen and potash, and No. 124, potash and phosphoric acid; *minimum*, No. 118, non-fertilized. No. 117, barnyard manure, and No. 119, nitrate of soda, *alike.*

Solids in Juice, maximum, No. 118, non-fertilized, and No. 125, nitrogen and phosphoric acid; *minimum*, No. 123, nitrogen and potash.

Sugars in Juice, maximum, No. 118, non-fertilized, and No. 121, potash; *minimum*, No. 124, potash and phosphoric acid, No. 119, nitrate of soda, No. 117, barnyard manure, and No. 120, superphosphate.

Acid in Juice, maximum, No. 118, non-fertilized, and No. 125, nitrogen, phosphoric acid, and potash; *minimum*, No. 123, nitrogen and potash, and No. 124, nitrogen and phosphoric acid.

Nitrogen, maximum, fertilized, respectively, with barnyard manure, nitrogen and phosphoric acid, nitrogen and potash, potash and phosphoric acid, and nitrogen, potash, and phosphoric acid; *minimum*, fertilized with muriate of potash.

a complete fertilizer, including barnyard manure, diminishes it as compared with the unfertilized fruit; and, further, that nitrogen and phosphoric acid, as in No. 122, do also increase sweetness, but not to the same extent as potash alone.

There is, then, in these results, if rigorously interpreted, such a mass of contradictions that we hesitate to attribute much weight to the whole series, until a repetition of the same modes of fertilization for several consecutive years or, better, until we shall have established some general principle with reference to each individual ingredient by large-scale experiments upon different soils of known character.

With regard to the nitrogen, it is again difficult to make any definite statement as to the effect of the several fertilizers, except that, obviously, the use of the muriate of potash has diminished the nitrogen-content of the fruit, and therefore its nutritive value in that respect. However, we do not know how much of this belongs to the rind and flesh, respectively, the small samples rendering the distinct determination impracticable. Nitrate of soda also lowered the nitrogen-content, as compared with the unfertilized fruit.

But the great drawback is that, as yet, we have no standard to go by for comparison. We do not know to what extent the different trees might differ from each other, if all were left unfertilized, in one and the same year or in different years.

That muriate of potash apparently increases sugar and decreases nitrogen, appears to be about the only definite indication we can draw thus far.

ORANGES FERTILIZED WITH POTASH SALTS.

The samples were grown by D. L. Wilbur, of the West Riverside Land Company, Riverside County, and are fair averages of the fruit from many five-year-old trees, and were not fancy selections; the aim being to have them of the same size, and grown under similar conditions. The soil is a fair average of that within the Gage Canal lands, which, according to analysis, contains .87 per cent of potash and .17 of phosphoric acid. To test the effect of potash fertilizers, samples were taken from trees that had had no application of the potash, and, on the other hand, from trees that a year previous had been fertilized with one pound of muriate of potash per tree. Both lots had an application of nitrates and phosphates. The trees of both lots are in good color and rank in growth, and no difference is notable between those fertilized and those non-fertilized. The oranges of the unfertilized trees were more elongated in shape than the others; the latter being, on the whole, well rounded, or more perfect in shape, and rather deeper in color-tint. The skin and "rag" were about the same for both lots, and rather thick and heavy, but easily separated from the flesh. The flesh was tender and juicy. The navel portion of many of the oranges of the unfertilized trees extends and spreads into the flesh, while that of the fertilized is confined to the end of the fruit.

ANALYSES OF NAVEL ORANGES FROM WEST RIVERSIDE LAND COMPANY. GROWN WITH AND WITHOUT MURIATE OF POTASH.

Serial Number	Name of Sample.	Date of Analysis.	Physical Analysis.					Proximate Analysis.					Analysis of Juice.				Whole Fruit.	
										Ash.							Nitrogen.	Albuminoids.
			Average Weight, in grams	Rind—per cent	Pulp, Pressed—per cent	Seeds—per cent	Average Juice, in cubic centimeters	Water—per cent	Organic Matter—per cent	Total Ash in Fruit—per cent.	Phosphoric Acid per cent in Ash	Potash per cent in Ash	Solid Contents by Spindle—per cent	Total Sugars (Inversion)—per cent	Cane Sugar (Polariscope)—per cent	Citric Acid—per cent	In the Whole Fruit, Total—per cent	Equivalent to Nitrogen in Flesh—per ct.
115	No. 1. Fertilized with Nitrogen and Phosphoric Acid—																	
	Original	Mar. 18, '95	267.8	31.03	31.65	0.0	100.0	85.0	14.64	0.36	18.55	50.90	12.40	11.72	6.33	.98	.199	1.244
	Duplicate	Mar. 19, '95		32.10	30.30	0.0	95.0						12.40	11.40	6.01	1.02		
	Average			**31.56**	**30.97**		**97.5**						**12.40**	**11.56**	**6.17**	**1.00**		
116	No. 2. Fertilized with Potash, Nitrogen, and Phos. Acid—																	
	Original	Mar. 18, '95	267.0	31.42	34.30	0.0	95.0	84.20	15.42	0.38	13.41	51.80	13.80	12.74	6.90	.95	.187	1.168
	Duplicate	Mar. 19, '95		29.06	34.70	0.0	98.3						13.60	12.28	6.56	1.05		
	Average			**30.24**	**34.50**		**96.6**						**13.70**	**12.51**	**6.73**	**1.00**		

A glance at the results of analysis shows that, while the oranges of the two lots were practically the same in weight, those not treated with potash have a thicker rind and a larger average of juice, and those treated with potash have a larger amount of pulp.

The ash of the oranges was nearly the same in both lots, but in that of the potash lot the percentage of potash is a little higher than in the other. Of phosphoric acid there is 5 per cent more in the no-potash lot.

In the juice, the potash seems to have had a slight effect in increasing the sweetness, as there is 1.3 per cent more in total sugar than in the other. The cane sugar was increased but .56 per cent. Had sulphate of potash been used instead of the muriate, the effect might have been greater. The citric acid was not influenced.

ANALYSES OF CALIFORNIA CHERRIES, CROP OF 1894.

Before the cherry season of 1894, requests were sent to a number of prominent orchardists for average samples of cherry varieties grown by them. A few were received in full-ripe and excellent condition, and submitted to analysis, with results given below.

No. 1. *Royal Ann*, from Chico, Butte County; grown by John Bidwell, and received for analysis June 8, 1894. The cherries were in excellent condition, quite large, and marked in color as characteristic of the variety; the flesh was hard and firm, and easily separated from the pit; juicy and sweet.

No. 2. *Black Tartarian*, from Chico; grown by John Bidwell, and received June 8, 1894. A typical lot of the variety.

No. 3. *Royal Ann*, from Newcastle, Placer County; grown by R. Hector, and received June 13, 1894. A pleasant-tasted fruit, somewhat smaller than that received from Chico (No. 1), but beautifully marked in its colorings.

No. 4. *Black Tartarian*, from Newcastle; grown by R. Hector, and received June 13, 1894. A very sweet cherry, though smaller than the others examined of the same name; color good.

No. 5. *Black Tartarian*, from San José, Santa Clara County; grown by J. Rock, and received June 19, 1894. A very sweet fruit, somewhat larger than the Newcastle sample (No. 4), and resembled much in color and size that grown at Chico (No. 2).

No. 6. *Napoleon Bigarreau* (Royal Ann), from San José; grown by John Rock, and received June 27, 1894. In size it was much like the other Royal Anns, but of higher brown color, which spread over the surface of the fruit, giving a rich appearance.

The accompanying tables contain (A) the proximate analyses of the fruits just described, with that of an Eastern-grown May Duke cherry; (B) the ash of the whole fruit (flesh and pits). No. 5 is that of the Black Tartarian from San José, and No. 7 that of a sample grown in Europe.

While the tables are not large, still, for the sake of bringing out some of the points there contained, it will be of service to explain them under a few headings:

Weight and Number per Pound.—The *largest* cherries are easily seen to be the Royal Ann from Newcastle and San José respectively, of which 54.1 made a pound. The *smallest* was the Black Tartarian from Newcastle, which required 72.9 to make one pound.

Flesh and Pits.—The *highest* flesh percentage is found in Royal Ann from Newcastle, 96.7 per cent; that of Royal Ann from Chico coming very near it with 96.0 per cent. The Black Tartarian from San José contains the *least* flesh (94.0 per cent), but at the same time is the juiciest fruit. The *driest* flesh is that of the Royal Ann from San José (No. 6), which has but 79.1 per cent of juice in the flesh; Nos. 3 and 4 possess but little advantage in this respect over No. 6, yielding, as they do, about 81.0 per cent juice in flesh.

Sugar-Content.—In the whole fruit we note some differences, but not as great as is shown by different varieties of prunes, or even by different lots of French prunes from various places. The Black Tartarian cherry from San José (No. 5) yields the most sugar, 12.75 per cent, and this was the juciest cherry examined. Aside from this lot there is but little choice, as the others show upwards of 10 per cent, leaving out the minimum (8.98 per cent) found in the Royal Ann from Chico (No. 1). These cherries, with an average of 10.96 per cent sugar, resemble *apricots*, which average with us 11.10 per cent sugar. A more extended comparison of sugars in fruits is easily made by reference to Report for 1893–4, page 331.

European-grown cherries show 10.24 per cent sugar in the fruit (König, Vol. II), this being one of the few instances where European and California fruits show agreement in this important ingredient.

Acid.—No great variation is noted in this constituent, ranging, as it does, from .30 to .50 per cent, or about as much in amount as is given for California prunes, plums, and peaches.

Nitrogenous Materials (*Albuminoids*).—The flesh, or edible portion of cherries, like the other pitted fruits, contains a very considerable quantity of nitrogenous matters. We note a variation in the albuminoids of the flesh of these cherries, of from 1 to 1½ per cent, giving an average of 1.20 per cent for all; this is the same as we have obtained for the apricot. This figure (1.20 per cent) is the highest for these nitrogenous materials (excepting that of 1.50 per cent for figs) in the series of fruits examined in this laboratory, and therefore places the cherry, as compared with other California fruits, on a high footing as to content of *flesh-forming* matters. (See also, page 272, Report for 1893–4.)

The analysis of the May Duke (Eastern-grown) cherry, given under No. 8 of the large table, indicates upon the whole fruit considerably *less* nitrogenous matters than we give above. König gives, as an average of nine analyses of *European cherries*, only .67 per cent albuminoids in fresh fruits, or about one half as much as we have found in our cherries.

Percentage Composition of Ash of Cherries.—The *ash* percentages are remarkably alike, averaging .440; only one lot, No. 6 (Royal Ann), reaching over ½ per cent, with .521. Nor does this fruit withdraw from the soil any more material than do the prunes, plums, and apricots, which contain, respectively, .486, .620, and .508 per cent ash. Turning now to the composition of the ash of cherries, given below, we see that over one half is composed of *potash*, and that the next largest ingredient is phosphoric acid, 15.11 per cent. Only one other fruit ash—that of *grapes*—contains more phosphoric acid, or as 21.24 per cent against 15.11; prunes come next, with 14.08 per cent phosphoric acid in ash. As to *lime* in ash, the grape, prune, apricot, and cherry all show in the neighborhood of 4 per cent—very much less than that in the orange,

ANALYSES OF CALIFORNIA CHERRIES, CROP OF 1894.

A.—PROXIMATE ANALYSES.

Number	Variety	Place of Production	Sender, or Grower	Date of Receipt and Analysis	Physical Analysis.											Proximate Analysis.								General Proximate Analysis.				Number
									Stems.	Flesh.		Juice.		Sugar.		Nitrogen.					Ash (Pure).							
					Average Weight, in grams	Number per pound	Flesh—per cent	Pits—per cent	Per cent of, in Berries plus Stems	Juice, Pressed—per cent	Pulp, Pressed—per cent	Total Sugar by Copper (Inversion)—per cent	Acid in terms of Sulphuric (SO_3)—per cent	In Fresh Flesh—per cent	In Fresh Fruit—per cent	In Whole Fresh Fruit—per cent	In Fresh Flesh—per cent	In Fresh Pits—per cent	In Fresh Stems—per cent	Albuminoids in Whole Fresh Fruit (equivalent to Nitrogen)—per cent	In Whole Fresh Fruit—per cent	In Fresh Flesh—per cent	In Fresh Pits—per cent	Water—per cen	Organic Matter—per cent	Ash—per cent	Total	
1	Royal Ann	Chico	John Bidwell	June 8, 1894	8.0	56.5	96.0	4.0	.66	82.0	18.0	11.41	.496	9.36	8.98	.183	.157	.644	......	1.140	.406	.383	.564	81.21	18.384	.406	100.00	1
2	Black Tartarian	Chico	John Bidwell	June 8, 1894	7.5	59.8	95.4	4.6	1.33	87.5	12.5	12.85	.306	11.21	10.64	.244	.201	.902	......	1.520	.403	.368	.736	81.88	17.717	.403	100.00	2
3	Royal Ann	Newcastle	R. Hector	June 13, 1894	8.5	54.1	96.7	3.3	.66	81.4	18.6	13.00	.384	10.58	10.05	.220	.191	.872	......	1.370	.414	.388	.784	81.21	18.376	.414	100.00	3
4	Black Tartarian	Newcastle	R. Hector	June 13, 1894	6.2	72.9	94.7	5.3	.66	81.0	19.0	15.03	.296	12.16	11.51	.242	.193	.912	......	1.412	.428	.388	.750	77.18	22.392	.428	100.00	4
5	Black Tartarian	San José	J. Rock	June 19, 1894	7.0	64.2	94.0	6.0	1.33	89.7	11.3	15.12	.268	13.66	12.75	.206	.160	.764	.389	1.287	.482	.446	.616	79.87	19.648	.482	100.00	5
6	Napoleon Bigarreau (Royal Ann)	San José	J. Rock	June 27, 1894	8.5	54.1	95.4	4.6	.66	79.1	20.9	15.77	.368	12.45	11.82	.278	.239	.807	......	1.727	.521	.483	.600	75.18	24.299	.521	100.00	6
8	*May Duke	Unknown			......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	1.100	.580	......	......	86.10	84.520	.580	100.00	8

* Bought in open market, Washington, D. C. United States Department Agricultural Reports, 1883, p. 235.

lemon, and fig ash. *Sulphuric* acid in the cherry ash is high—even more than we report for oranges—5.83 against 5.25 per cent. With the ash analysis of our cherry we give one of European-grown fruit (E. Wolff, *Ashen-Analysen*, p. 126), in which we find the *total* ash to be over four times greater than that in our fruit.

TABLE B.—ANALYSES OF THE ASH OF CHERRIES.

	Black Tartarian, from San José, California.	European Cherry.
Percentage of pure ash in fresh fruit	4.82	2.20
Percentage Composition.		
Potash	57.67	51.85
Soda	6.80	2.19
Lime	4.20	7.47
Magnesia	5.49	5.46
Peroxid of iron	1.12	1.98
Br. oxid of manganese	.82	----
Phosphoric acid	15.11	15.97
Sulphuric acid	5.83	5.09
Silica	1.13	9.04
Chlorine	1.83	1.35
Totals	100.00	100.40
Less excess of oxygen due to chlorine	.46	
Total	99.54	

König gives as an average of nine analyses of European cherries, total ash, .73 per cent—just about twice as much as we have found in the California cherries. The European ash analysis agrees with ours as to *potash*, *phosphoric* and *sulphuric acids*.

For comparison with table on page 333 of Report of this Station for 1893–94, we have calculated the

Soil Ingredients Extracted by 1,000 pounds of Fresh Cherries.

Total ash		4.82 lbs.
Potash	2.77 lbs.	
Phosphoric acid	.72 lbs.	
Other ash ingredients	1.33 lbs.	
Nitrogen		2.29 lbs.

The above figures are very similar to those given for apricots; we may therefore conclude that for cherries when fertilizers become necessary a nitrogenous as well as phosphatic one will be required *first*, leaving the potash fertilizer to follow at a much later time, as California soils are usually so well supplied with this substance. The high sulphuric acid in the ash of the cherry, as in the orange, might indicate the early use of a dressing of gypsum to supply this ingredient, its benefit being in this case two-fold, as it helps to make available the potash already present.

EXAMINATION OF PRESERVATIVE LIQUID OF "MARASCHINO CHERRIES."

Sent by Wm. Wehner, of Evergreen, Santa Clara County. Two samples: No. 1, Bigarreau Rose au Marasquino; No. 2, Bigarreau au Marasquino.

	No. 1.	No. 2.
Specific gravity	1.2210	1.1870
Alcohol—By volume	2.70	11.40
By weight	.94	7.64
Sugar—Reducible (dextrose and levulose)	49.00	34.50
Cane	0.00	10.00
Total	49.00	44.50
Specific gravity of de-alcoholized liquor	1.2280	1.2045
Solids of de-alcoholized liquor	49.20	44.80
Boracic acid	quite st'ng.	quite st'ng.
Salicylic and cyanhydric acids	none.	none.

The above shows the composition of the liquids which have been used in the preservation of the cherries. The fruit itself, of course, is permeated with the same liquid, the cherry juice having equalized itself with the outside syrup. The analysis, therefore, shows the liquid somewhat weaker than when it was poured over the cherries. It is probable that, in both cases, the syrup contained about 55 per cent of sugar before the addition of alcohol. The greater addition made to No. 2 corresponds to the smaller amount of sugar at present in the liquid.

It is evident that in No. 1, where the amount of alcohol is quite small, air-tight sealing was at least partially relied upon for conservation; while in No. 2, the preservative action of the alcohol and sugar was deemed sufficient; there is, at the same time, a very obvious addition of boracic acid.

As regards the hardness of the cherries, it is quite evident that it has been produced by means of either strong sugar syrup or alcohol, in which the fruit was previously immersed for that purpose. A few hours' immersion of one of the cherries in water, suffices to swell it to such an extent that a string closely tied around the original fruit cuts the skin. This could hardly have been done simply by immersion in the present preservative liquid, unless the fruit originally taken were of such solid-fleshed varieties as the Centennial and a few of the Bigarreaus. (E. W. H.)

ADDITIONAL PROXIMATE ANALYSES OF PRUNES, PLUMS, AND PERSIMMONS.

(Samples sent by growers for examination.)

The following little table contains work upon prunes and plums done at the request of the growers. All the samples examined were in good condition.

No. 64. *Oregon French Prune*, was small, more red colored than our prune; base rather pointed in most of the fruit examined; flesh tough and readily separated from the pit.

No. 63. The *Tennant Prune*, originated in Oregon, and grown here in Santa Rosa by R. W. Bell; sample not quite as large as the Hungarian as grown here.

No. 65. The *Italian Prune*, from W. E. Payne, of Salem, Oregon, resembles the Fellenburg as here produced; was good sized and purple colored.

No. 73. *Primordian Plum*; in size resembles the average French prune, but the flesh is hard, and poor to the taste as to sugar. The pits are ovate and very flattish shaped.

No. 74. *Simon Plum* (*Prunus Simoni*), from Lincoln, Placer County; grown by Wm. Foster, and received July 1, 1895. A large fruit, but not very juicy; the pit is small.

The French prune from Oregon (No. 64) shows very much less sugar than the average California-grown French prune—6.90 per cent, as against 18.50 per cent sugar in the whole fruit. This difference may be due to improper selection of sample, as it seems incredible that such a wide difference should occur.

The Tennant prune (No. 63) resembles in sugar-content (9.4 per cent) the Hungarian and some of the hard-fleshed prunes.

The dried French prunes from the summit of the Santa Cruz Mountains, near Patchen, are interesting, as they show some of the highest sugar-percentages obtained for California dried prunes, although their size is inferior to many.

The dried French prunes from Wrights (No. 70) are claimed by the grower to be identical with No. 60 of last year; *i. e.*, the same prunes kept one year. The earlier lot showed 48.4 per cent of sugar, and the last lot 50.6 per cent. The grower explained that some claim of deterioration was made against these lots of fruit, due to fermentation caused by perforation; but the fact that both lots are of the same size, taste, and sugars seem to be enough to prove that the fruits had not sustained any injury by keeping.

The dried prunes from Wrights (Nos. 71 and 72), while small in size, show high sugars—No. 71, perforated, yielding about 1 per cent more sugar than the lye-cured lot (No. 72), a difference not great enough to warrant any conclusion upon the methods of curing.

The Primordian plum (No. 73) does not yield within 4 per cent as much sugar, on the average, as the other *plums* examined here, and nearly 10 per cent less than the average French prune.

The Simon plum (No. 74) carries a very small pit, is very low in sugar-content, and is rather tart to the taste.

Further comparison of all these results may be made by reference to our last annual report (1893–4), pages 257–271.

PROXIMATE ANALYSES OF PRUNES AND PLUMS, CROP OF 1894.

Number	Variety.	Place of Production.	Name of Grower.	Date of Receipt and Analysis.	Average Weight, in grams	Number per Pound	Flesh—per cent	Pits—per cent	Flesh.		Juice.		Sugar.		
									Juice, Pressed—per cent	Pulp, Pressed—per cent	Total Sugar by Copper (inversion)—per cent	Acid, in terms of Sulphuric(SO_3)—per cent	In Fresh Flesh—per cent	In Fresh Fruit—per cent	In Dried Fruit, Whole—per cent
	Prunes.														
61	French	Chino	J. W. Lawson	Sept. 13, '94	20.5	22	95.1	4.9	82	18	22.00	.25	17.70	16.80	-----
62	French	Middletown	J. Pentacost	Sept. 21, '94	27.5	16.4	93.4	6.6	90.5	9.5	23.10	.24	20.80	19.50	-----
63	Tennant	Santa Rosa	R. W. Bell	Sept. 13, '94	-----	-----	-----	-----	-----	-----	-----	-----	-----	9.40	-----
64	French	Salem, Oregon	W. E. Payne	Oct. 8, '94	13.5	33.4	94	6.0	76	24	11.16	-----	8.90	6.90	-----
65	Italian	Salem, Oregon	W. E. Payne	Oct. 8, '94	27.4	16.5	94.9	5.1	71.6	28.4	13.00	-----	9.30	6.90	-----
	Dried Prunes.														
66	French	Middletown	J. Pentacost	Sept. 21, '94	11.6	39	85.7	14.3	-----	-----	-----	-----	-----	-----	35.20
67	French (8 yr. old trees)	Patchen	J. Nonish	Dec. 12, '94	4.0	113	-----	-----	-----	-----	-----	.88	-----	-----	51.00
68	French (needle-cured)*	Patchen	J. Nonish	Dec. 12, '94	6.2	73	-----	-----	-----	-----	-----	.80	-----	-----	50.00
69	French (10 yr. old trees)	Patchen	J. Nonish	Dec. 12, '94	-----	-----	-----	-----	-----	-----	-----	.80	-----	-----	53.00
70	French (needle-cured)	Wrights	H. C. Morrell	Dec. 13, '94	-----	44	-----	-----	-----	-----	-----	.88	-----	-----	50.60
71	French (perforated)	Wrights	A. H. Allen	Jan. 7, '94	-----	80	-----	-----	-----	-----	-----	-----	-----	-----	50.80
72	French (lye-cured)	Wrights	A. H. Allen	Jan. 7, '94	-----	90	-----	-----	-----	-----	-----	-----	-----	-----	49.00
	Plums.														
73	Primordian	Niles	J. Shinn	July 3, '94	11.0	41	94	6.0	87	13	10.41	-----	9.05	8.50	-----
74	Simon	Lincoln	Wm. Foster	July 1, '95	67.0	6.7	97.1	2.9	80.0	20.0	6.25	.82	5.00	4.80	-----

* Six-year-old trees.

PARTIAL ANALYSIS OF SEEDLESS PERSIMMON.

This persimmon is of the variety known as Seedless, imported from Japan by James Shinn, in the seventies. There is a good deal of uncertainty about varieties of the persimmon, because they have been imported under many different names and from different districts. This is probably the *Tana-nashi* of Professor Van Deman, and the *Imperial* of Loomis. It is one of the sub-varieties of the group of large seedless persimmons, pointed in shape and orange-red in color. Mr. P. J. Berckmans, of Georgia, names this the *Hiyakume*, which was the name under which Mr. Shinn received it. This sample, received on January 9, 1895, was analyzed on the same day, with the following result:

Average weight in grams (30 grams are equivalent to 1 ounce)	175.00
Total sugar per cent	18.20

This sample contains nearly as much sugar as the fresh French prune with 18.50, and the White Adriatic fig with 19.20 per cent sugar, though it is some 2 per cent behind the average California grape in this respect. It is much sweeter than the apricot with sugar at 11.10 per cent, the plum with 12.89 per cent, and the peach with 12.50 per cent.

ANALYSIS OF THE LOGAN BERRY.

The sample was taken from the University Experimental Grounds, Berkeley, July 12, 1894, and analyzed, with result given below. In the Annual Report for 1893–4, there is a full description and photograph of this large berry:

Physical Analysis.	
Average weight, in grams	5.00
Number of fruits per pound	90.40
Pulp (pressed), per cent	11.93
Juice (pressed), per cent	88.07
Juice.	
Total sugar, per cent	8.90
Acid, in terms of sulphuric (SO_3), per cent	.96
Sugar.	
In whole fresh fruit, per cent	8.00
Nitrogen.	
In whole fresh fruit, per cent	.175
Albuminoids (N × 6.25) in whole fresh fruit, per cent	1.094
General Proximate Analysis.	
Water, per cent	85.71
Organic matter, per cent	13.90
Ash (pure), per cent	.39

Another sample of this berry was received from Major Logan, of Santa Cruz, but was evidently picked too soon, for the acid-percentage of the juice was higher (1.35) and the sugar lower (5.49) than in the University sample. It was then impossible to secure more mature berries from Major Logan. In order to compare the composition of the Logan berry with that of the raspberry and blackberry (of which two it is a cross), and the strawberry, the table below has been compiled. It is unfortunate that we are unable to present analyses of our own California-grown berries, in order to avoid differences that might be due to the climate and soils of other countries. A specimen of raspberries was received from Major Logan, of Santa Cruz, California, but not in good condition. Its analysis is, however, included in the table.

Comparison of Some of the Ingredients of Raspberries, Blackberries, Strawberries, and the Logan Berry.

In the Fresh Material.	Logan Berry.	Raspberries.			Blackberries.		Strawberries.
	Experiment Station, Berkeley	Santa Cruz, California	U. S. Dept. Agriculture Analyses	European Analyses	U. S. Dept. Agriculture Analyses	European Analyses	Experiment Station, Tennessee
Water, per cent	85.71	--------	85.82	85.74	88.91	86.41	90.52
Organic matter, per cent	13.90	--------	13.53	--------	10.61	13.81	8.86
Ash, per cent	.39	--------	.55	--------	.58	.41	.62
Albuminoids, per cent	1.09	--------	.99	--------	.94	--------	.99
Total sugar, per cent	8.00	7.59	--------	3.86	--------	4.14	5.36
Acid (as sulphuric), per cent	.84	1.04	--------	--------	--------	--------	1.00

A glance at these results shows that the Logan berry is by far the sweeter of the four varieties of berries, and contains even more sugar than the strawberry. That this may be due to climatic conditions is indicated in the correspondingly high sugar in the juice of the California-grown raspberry, which has twice the sugar contained in the European berry. In other particulars, there is but little difference between the several classes of berries.

STARCH IN BUCKEYE FRUIT (ÆSCULUS CALIFORNICA).

The question has frequently arisen as to the amount of starch in the fruit of the buckeye, and for information the following partial proximate analysis was made. The samples examined were fully ripe, and gathered from a tree growing upon the University Grounds at Berkeley.

Partial Analysis of Buckeye Fruit (*Æsculus Californica*).

Date of Taking Sample:	No. 1. Dec., 1894.	No. 2. Nov., 1895.
Water, per cent	68.75	67.50
Starch, per cent	13.90	14.56
Other organic matter, per cent	16.14	17.94
Ash (pure), per cent	1.21	
Totals	100.00	100.00

The starch grains of this fruit are irregular oblong-elliptical in shape, appearing somewhat like a potato; in size, they are about like those of arrow-root starch—the average is decidedly smaller than potato-starch grains.

Calculating the starch upon a uniform water-content (10 per cent), the buckeye stands as placed below when compared with corn and potatoes:

	Water—Per Cent.	Starch—Per Cent.
Corn	10.0	64.0
Potatoes	10.0	78.3
Buckeye	10.0	36.6

The buckeye fruit is not, therefore, as rich a material for the manufacture of starch as has been supposed by some persons.

PARTIAL ANALYSIS OF COMMERCIAL ALBUMEN (FOR WINE FINING).

The sample was sent by Beringer Bros., of St. Helena, California.

Total ash, per cent	5.15
Part soluble in water, per cent	4.62
Part insoluble in water, per cent	.53

The soluble part consists mostly of chlorid and sulphate of sodium.

The insoluble part gives a good test for chromium, which greenish color is also perceived in the filtered solution of the albumen. Under the microscope, well defined crystals (blue in color) of chromium oxid are seen.

EXAMINATION OF LICORICE ROOTS.

The undried samples were received from Ant. C. Denotovich, of Fresno, California, who calculated that they would, when dry, show a shrinkage of about 55 per cent. They were grown on the "white ash" land of the San Joaquin Valley, near Fresno. A careful examination gave the following result:

	Per Cent.
Extract in the "green," or fresh, roots	22.80
Extract in the air-dried sample	42.22
Total sugar in the "extract"	17.00
*Glycyrrhizin in the "extract"	14.70

Licorice has been grown on a large scale for some time by parties near Stockton on partly sandy, partly adobe land, also in the Garden of Economic Plants, of the University of California, for ten or more years, and does well. The only question in its culture is the commercial one as to whether it can be profitably grown with our expensive labor, in competition with Europe and Asia Minor. There are millions of acres of soil well adapted to the culture, both in California and Oregon, where a native species, also with a sweet root, grows wild and is a great pest in certain soils. The licorice plant becomes a weed when allowed to escape from cultivation in certain favorable soils. The wild licorice of this country is very largely found on alkali land.

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*Determined by method given in Vol. II, *Nahrungs- und Genussmittel* by König, p. 751.

THE CAÑAIGRE, OR TANNER'S DOCK.

By E. W. Hilgard, Director and Chemist.

(Revised from Bulletin No. 105.)

The cañaigre, or tanner's dock (*Rumex hymenosepalus*), has of late attracted so much attention as a promising field-crop, and forms the subject of so many letters of inquiry addressed to this Station, that it seems desirable to summarize, for the benefit of the public, the various results obtained and publications made in regard to it, here as well as elsewhere, in order to enable every one to form his own judgment in regard to the probable merits of the culture for this State. Thus far, the best source of information on this plant is Bulletin No. 7 of the Arizona Experiment Station at Tucson.

Character of the Plant.—The cañaigre plant, though recognizable as a dock by any attentive observer, differs from most of the common species in being of less height (rarely over two feet in this State) and more succulent; the stem rather brittle, the lance-shaped leaves smoother and of a lighter green than most others, perfectly smooth, and red-veined. The flowers and seeds are less abundant and larger than in our other docks; are borne on erect branches, and are suspended by longer and thinner, reddish-colored stalklets. The seed-vessels are conspicuously winged and reddish, with a very small black seed. The tuberous roots resemble sweet potatoes or dahlia roots; single ones weigh from six to fourteen ounces each, and from one to four are found with a single stalk.

Distribution and Supply.—The cañaigre is indigenous to Southern California as far north as the Kern Valley, so far as known; it is more particularly at home, however, south of the Tehachapi Mountains, in the sandy lands of the San Fernando and San Bernardino plains; also on the San Gorgonio Pass, and on the border of the Colorado Desert generally; also, no doubt, in the valleys of San Diego. Outside of California it is apparently most abundant in Arizona and southern New Mexico, and in northwestern Texas; it reaches to Utah and the Indian Territory. Its abundant occurrence in New Mexico led to the establishment of a factory for preparing the tannin extract for shipment instead of the root, and similar establishments were proposed for Arizona. But it has quickly become apparent that the supply of the wild plant would soon become exhausted, and that, in order to place the industry upon a permanent basis, it would be necessary to grow it as a regular crop. Now that the value of the root for the tanning of fine leathers has been fully established and a market is assured, the only remaining question is that of the best conditions for its cultivation, as to climate, soil, variety, and mode of culture to insure profitable returns.

Climate.—As regards climate, it should be understood that, in California, the plant starts its growth from the root with the first rains, in October or November, reaches bloom about the end of January or first part of February, perfects its seed about April, and dies down to the ground in May, varying according to the winter temperature and the advent of spring warmth. It is not, therefore, to be expected that it will make a normal growth where the ground freezes in winter, although, like some other culture plants, it may be able to adapt itself to a different *régime* so long as the root is not frosted. We have not, as yet, any definite data as to what amount of winter cold will kill the root, except that a letter received from Arthur Stayner, Esq., of Salt Lake City, informs us that cañaigre roots planted in the fall of 1894, lived through the winter when the lowest temperature reached was about zero, and in April were growing finely.

Soils.—As to soil, the presumption is that, like other root crops, it will do best in light soils, which it seems to occupy naturally by preference. Yet it has made a good normal growth in the heavy black adobe of the Economic Garden, at this Station, which has, of course, been kept well tilled. It appears, therefore, to be quite adaptable to a variety of soils. The New Mexico station reports "adobe soil" as its preferred ground, but the term is evidently used there in a different sense, as designating the loams of the character actually used for building adobe houses; a use for which the average adobe of California would be inapplicable.

Propagation, Cultivation, Harvesting, and Marketing.—The easiest way to obtain a stand of the cañaigre, is to plant the smaller roots obtained in harvesting the crop. These develop rapidly, and, according to the observations made at the New Mexico station, will when irrigated quadruple their weight in one season; they will, also, in that case, produce seed abundantly. One peculiarity of the roots, remarked upon by all reports, is that when cut, the upper portion (the one having the root-crown) will reconstruct its lower part by new growth, which differs markedly from the older by its smoothness and light tint.

Propagation by seed seems to occur quite rarely in Arizona and New Mexico, as well as in California south of the Tehachapi range. But with more abundant moisture, as in the "Weed-patch" of the Kern Valley (an ancient channel still receiving some seepage), and at this Station, when early rains occur, the fallen seeds sprout abundantly; and we will, the coming season, be enabled to ascertain what advantage there may be in propagating by seed, instead of devoting a portion of the root-crop to replanting. The seed must be sown quite shallow and lightly covered, when the ground is moist.

When irrigated, the roots will stand close planting, say nine or ten inches apart in rows thirty inches apart, as in the case of sugar beets. Since the roots are, on the average, somewhat smaller than sugar beets, the average crop will be somewhat less in weight.

Cañaigre roots will sometimes remain in the ground during several successive dry years without injury, growing as soon as the needful moisture comes. This indicates the mode of keeping the roots for seed, viz., in dry sand or loam, in a dry place. When kept in piles for any length of time, the cañaigre root heats and spoils even quicker than the sweet potato.

Cultivation will, it must be presumed, not differ materially from that of the sugar beet, except that there will be no thinning needed; and, as in the case of the latter, only a few cultivations will be required to subdue weeds and to maintain good tilth, in the rainless summer climates in which it is at home. The Arizona station prescribes that, "to secure the largest yield, the planting should be done before the first of October (in that climate), and the soil moistened and plowed; then the roots dropped and covered with a potato-planter adjusted to suit the case. The crop should be irrigated from four to six times, and some implement of the two-horse cultivator style run through the rows after each irrigation."

The amount of irrigation that should be given will of course vary according to the kind of soil and the natural moisture. As it seems that too much water depresses the tannin-percentage (see below), while increasing the weight of the crop, there is evidently a certain measure that cannot be profitably exceeded, but which must be established by experiment. At this Station, with an average rainfall of 23 inches during the winter, irrigation is certainly not called for.

Harvesting can be done, as in the case of beets, by means of a "digger," such as is used for potatoes and (in a modified form) for the sugar beet. A crop of ten tons per acre from roots planted as indicated above, and properly cultivated for one season, is probably a fair average expectation. But it is not necessary to harvest the root at any particular time, since it not only does not deteriorate by remaining in the ground, but actually increases its tannin-percentage about the time the buds for the second year's growth begin to move; as has been shown at the Arizona station. In fact, the tannin appears to increase to a maximum at the end of the second season, after which it seems to remain constant; at least, we have never found a higher percentage in roots older than two years, than in the two-year-old. As the roots do not die nor decay, it is optional with the farmer when to dig them. At this Station, when a clump, that had grown from a single root, was dug up after remaining undisturbed for eight years, not a decayed root was found, and the whole weighed thirteen pounds. The older roots are much darker in color and have a rougher surface than new roots, which are as smooth as sweet potatoes. The cañaigre thus differs from almost every other crop, in that its harvests can wait for the convenience of the farmer, within wide limits. It is not certainly known, as yet, whether the root increases in weight after the second year; our impression is that the increase is slight, if any, and that it will not be found best to defer harvesting after the second year. But we have found that there is no material difference in the tannin-content of the full-grown root, whether the plant is resting, blooming, or seeding.

Marketing.—As has been stated above, the cañaigre root, while an excellent keeper when kept very dry, spoils readily when kept in mass. It cannot, therefore, be shipped green to any great distance, but must, for distance shipments, be either dried or converted into extract. Drying is costly and laborious, and, after all, of somewhat uncertain result on the large scale. Tannin is a very easily decomposable substance; drying at a high temperature will injure it as well as when, at too low a temperature, the drying progresses too slowly, and permits fermentation to start up. Even small roots cannot be dried whole without serious deterioration; it is absolutely necessary to slice them, very much as beets are sliced for sugar-making. But when machinery is once procured for slicing, it seems better to go a step farther and end all fear of deterioration by preparing the *extract*, which will keep indefinitely. The cost of a factory plant for preparing the extract need not be large, but it must be managed by competent hands. According to the data obtained by the Arizona station, agreeing well with the averages obtained by us, three tons of green roots will make one ton of dried, or a half ton of extract; or, six tons of green root will yield one ton of extract, averaging from 60 to 65 per cent of tannin, and therefore very well capable of shipment to a distance, so far as value is concerned.

Structure and Chemical Composition of the Root.—As the cañaigre root varies in its outward aspect, so it also differs quite obviously in its internal appearance. Old roots are darker-colored than the young ones, both outside and inside; the latter point seems also to be influenced by differences in soil and cultivation. The fresh root shows on a cut surface irregular orange or lemon-yellow blotches and streaks, sometimes covering the greater part of the section almost uniformly. On exposure to the air the color rapidly darkens into brownish-red, which is also the color of the extract as a whole. Microscopic examination shows that the coloring substance (aporetin?) is contained in separate cells almost free from starch grains, while the uncolored tissue is full of starch. The tannin appears to be very uniformly distributed throughout, in solution in the sap; but in the case of large roots appears to be most abundant near the axis or center line, contrary to what occurs in the case of sugar in the beet.

The tannin-content of the fresh and dried root from different localities, of different ages, etc., as heretofore determined by Messrs. Colby and Jaffa, at this Station, are given in the subjoined table; for the sake of comparison, the tannin-percentages found in other materials available in this State are also given.*

The first analysis in the table was published in the report of the U. S. Department of Agriculture for 1878, and refers to (dried) roots from northwestern Texas. It will be noted that the tannin-percentage there given (26.4 on the average) is the lowest of all the results obtained from wild roots. The Arizona station gives as the average of wild roots from that Territory 30.50 per cent of tannin, while the average of the wild roots from California is seen to be 35.85, or 5.35 per cent higher. Whether this is due to climatic or soil differences remains to be determined. The fact that large roots from the San Gorgonio Pass and from the Berkeley Economic Garden both yielded the maximum percentage (38.50), while the soils are respectively at the opposite extremes of sandiness and clayeyness, would seem to indicate climatic factors as the more probable cause of difference. At all events, it appears clearly that the California-grown root is likely to be superior, rather than inferior, to that grown farther south.

As regards the relation of tannin-content to *color*, analyses 5, 6, 12, 13, 15, 16, 30 to 34 furnish some interesting indications. It appears that in Kern County the cañaigre is known as "red dock," probably more from its red leaf-stalks and veins than because of the color of the root. There is a variation in the color which is expressed by the popular names of "white red" and "red red" dock, while there is also a kind called "white dock." The latter, as the table shows, is a different species, and contains only traces of tannin; the "white red" has only a little over 20 per cent, the "red" (No. 12) 29 per cent, the "red red" 35 per cent. But in the last four analyses (Nos. 31 to 34), from Brent-

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* The tannin determinations given here have been made by the permanganate method, but have been repeatedly checked by the gelatine (or hide scrap) method, with but trifling differences in the results. These, therefore, represent fairly what hides will take up from the root or root extract.

ANALYSES OF THE CAÑAIGRE ROOT. By G. E. Colby and M. E. Jaffa.

	Material.		Locality.	Sender or Grower.	Water—Per Cent.		Tannin—Per Cent.		
					Fresh.	Air-Dried.	Fresh.	Air-Dried.	Dried at 100° C.
1	Cañaigre‡ (root of *Rumex hymenosepalus*)		Northwestern Texas	-----	*68.07	11.17	8.51	23.45	26.30
2	Cañaigre		San Gorgonio Pass	Dr. C. C. Parry	*75.00	11.40	9.60	34.20	38.40
3	Cañaigre, roots sliced and dried		San Gorgonio Pass	Dr. C. C. Parry	-----	-----	-----	14.97	16.90
4	Cañaigre, roots dried whole		San Gorgonio Pass	Dr. C. C. Parry	-----	-----	-----	5.40	6.09
5	Cañaigre, roots with little coloring matter	Gathered April 10, 1889.	Experimental Garden, Berkeley.	-----	83.00	-----	5.91	30.80	34.76
6	Cañaigre, roots highly colored			-----	83.00	-----	5.97	31.13	35.14
7	Cañaigre, outside sections of root			-----	83.00	-----	5.60	27.64	31.20
8	Cañaigre, inside sections of root			-----	83.00	11.40	7.79	40.57	45.80
9	Cañaigre root, small			-----	83.00	-----	7.10	37.03	41.79
10	Cañaigre root, large			-----	83.00	-----	6.54	34.11	38.51
11	Cañaigre root (gathered May 20, 1889)		-----	-----	-----	-----	5.80	30.21	34.12
12	"Red Dock" (wild)		Weed-Patch, Kern Co.,	L. H. Filcher	-----	12.50	-----	25.30	29.00
13	"White Red Dock" (wild)		South Fork Kern River	A. B. Leckenby	*61.40	10.50	7.50	17.43	20.30
14	Cañaigre; one year old, grown with irrigation		Bakersfield, Kern County	A. B. Leckenby	*74.80	11.10	4.35	15.35	17.80
15	"Red Red Dock" (wild); on moist ground		Weed-Patch, Kern County	A. B. Leckenby	*74.20	12.66	9.00	30.70	35.10
16	"White Dock" (*Rumex Berlandieri ?*)		Weed-Patch, Kern County	L. H. Filcher	48.88	-----	.00	.00	.00
17	Cañaigre, from bunch weighing 63 pounds		Weed-Patch, Kern County	A. B. Leckenby	72.50	12.14	7.55	29.47	33.54
18	Cañaigre, light colored		Weed-Patch, Kern County	A. B. Leckenby	75.00	10.27	7.63	27.39	30.52
19	Cañaigre, uniformly colored		Weed-Patch, Kern County	A. B. Leckenby	*67.00	11.49	11.45	30.72	34.70
20	Cañaigre		Mexico	D. E. Josephi	*66.20	11.00	12.88	†25.31	28.40
21	Cañaigre, youngest	From one bunch	Kern County	D. E. Josephi	72.70	11.00	8.61	20.75	23.10
22	Cañaigre, next youngest		Kern County	D. E. Josephi	70.30	11.00	7.33	21.99	24.70
23	Cañaigre, oldest		Kern County	D. E. Josephi	73.30	11.00	8.09	26.97	30.30
24	Cañaigre		Kern County	D. E. Josephi	75.10	11.00	7.22	25.73	29.00
25	Cañaigre (dried in small blocks)		Kern County	D. E. Josephi	-----	-----	-----	16.72	-----
	Cañaigre (dry and sliced for shipment)		Kern County	D. E. Josephi	-----	-----	-----	26.12	-----
26	Cañaigre, one year from seed		Experimental Grounds, Berkeley.	-----	73.50	-----	-----	14.63	-----
27	Cañaigre, two years from offsets			-----	70.00	-----	-----	28.21	-----
28	Cañaigre, three years old			-----	77.70	11.00	9.24	37.35	41.90
29	Cañaigre (punctate surface)		Arizona	Expt. Station	-----	-----	-----	34.98	-----
30	Cañaigre (uniform surface)		Arizona	Expt. Station	-----	-----	-----	29.26	-----

31	Cañaigre (solid orange appearance)	Brentwood, California	C. Steenbergh	....	....	....	29.78	....
32	Cañaigre (white rind, yellow center)	Brentwood, California	C. Steenbergh	....	....	....	30.82	....
33	Cañaigre (white rind, yellow center)	Brentwood, California	C. Steenbergh	....	....	....	31.35	....
34	Cañaigre (almost solid white)	Brentwood, California	C. Steenbergh	....	....	....	25.08	....
	Other Tanning Materials.							
	Black Wattle (*Acacia decurrens*); bark	Experimental Grounds, Berkeley.	....	45.70	14.85	26.40	41.40	48.60
	Silver Wattle (*Acacia dealbata* var. *mollisima*); bark		....	47.99	20.49	13.10	19.70	24.80
	Golden Wattle (*Acacia pycnantha*); bark		....	41.10	11.19	27.60	41.60	46.80
	European Tanner's Sumac (*Rhus coriaria*); leaves		....	....	10.20	....	16.80	18.70
	California Tall Sumac (*Rhus integrifolia*); leaves	San Fernando Plains, Los Angeles County	....	....	....	....	11.70	....
	California Tan-bark Oak (*Quercus densiflora*)	....	....	....	....	....	12.00	....
	Oak¶ (*Quercus pedunculata*); bark	....	....	....	....	....	10.50	....
	Hemlock¶ (*Abies canadensis*); bark	....	....	....	....	....	12.00	....
	Pomegranate peels	Whittier, California	Mrs.H.W.Strong	....	....	....	32.58	....

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‡ Analysis taken from Report of Secretary of Agriculture, 1878.
¶ Analyses taken from Allen's Commercial Organic Analysis, VIII.
† The same by the hide-powder process yielded 25.3.
* Partially dried in transmission.

wood, this point is especially emphasized, the solid white root showing more than 5 per cent less of tannin than white rind and yellow center.

It is thus evident that, in the case of the cañaigre as well as in that of other culture plants, there is a considerable variation in the quality of different varieties; and it seems that the deeper the tint of the foliage (and root), the greater the tannin yield is likely to be. Doubtless in the future we shall be able to improve the cañaigre in this respect, as the sugar beet has been. But it is also clear that the extent of moisture and irrigation has a very great effect in this direction; since we see that the well-irrigated plant from the experimental field of the Kern County Land Company, near Bakersfield, yields only 17.8 per cent, or about half as much as the best wild plant.

Analyses 2, 3, and 4 show plainly the effects of drying in various ways. No. 2 was rapidly dried by steam heat after cutting into very thin slices; No. 3 was cut more thickly, and placed in a drier on a tray, as might be done on the large scale; No. 4 was dried whole at a gentle heat. It will be noted that while the first contained an unusually high percentage, the second was reduced to less than half, and in the third five sixths of the tannin was destroyed by the process.

Analysis No. 25 again shows the difference between drying in small blocks and in thin chips, one and the same sample. The former had but 16.7 per cent of tannin as against 26.1 per cent—a difference of nearly 10 per cent in favor of the thin chips. In this case, 36 per cent of the tannin was lost in the block drying.

Other Tanning Materials.—Comparing the cañaigre with other tanning materials given in the table, it will be seen that the bark of the black wattle and golden wattle exceeds the root in tannin-content. The question then arises whether, supposing the two materials to be of equal quality for tanning purposes, it will be more profitable to grow cañaigre than the wattles. An approximate, comparative estimate for the crops will, therefore, be of interest. Here the time-element comes in as an essential factor. It takes eight or ten years to mature a wattle plantation; the yield of bark per acre is, for the first eight years (for the black wattle), estimated at about 12 tons, besides, possibly, 100 cords of wood, available for firewood. This estimate is based upon the planting of 400 trees per acre; close planting being desirable in order to secure long trunks. The bark is worth about $25 per ton in Australia. At the end of eight years, twenty acres will yield 240 tons of such bark (value $6,000), plus 2,000 cords of trunk wood, which would barely bring $1 per cord in this country. Therefore, $8,000 represents the gross returns for the twenty acres, as against about $2,050 of cash outlay, plus rent of land, interest, wear and tear, etc. The clearing of the land for replanting would cost from $40 to $50 per acre, so that $800 to $1,000 must be added to the above estimate of cost; leaving as the net returns for the eight years, about $5,000. On the other hand, we would have, in the case of cañaigre, estimating on the cost of the cultivation of sugar beets, and allowing for the differences in the operations required, about $3,000 for the eight years, plus again the rent of land, interest, and wear and tear. In return for this, at the rate of 10 tons of roots per acre, there would be obtained 1,600 tons of fresh roots, worth $8,000 upon the basis of the price of beets only ($5 per ton).

According to the prices as above estimated, the outcome of the eight years' culture would be very nearly the same for black wattle and cañaigre. But the returns from the latter, unlike the former, would bear interest during the eight years; and the wide climatic range of the cañaigre renders it much more widely available. This presupposes that the tannin of both plants will, in commerce, bring about the same prices. But it is well known that the acacia tannin is not available for the tanning of fine leathers, for the reason that it tends to render them somewhat brittle. But if, as we are now informed, the tannin of cañaigre (rheo-tannin) is well adapted to *most* purposes, including the finest leathers, it will go far towards throwing the balance still further on the side of the root as against the trees, particularly where the price of labor and capital is high.

Ash Composition and Nitrogen-Content of the Cañaigre Root.—In its draught upon the soil ingredients, the cañaigre differs from the beet and most other root-crops in drawing much less heavily on potash, but more heavily on magnesia, and on phosphoric and sulphuric acids. The following table illustrates these points. The ash analysis of the root grown at this Station was made by Mr. P. W. Tompkins. That of the sugar beet, placed alongside, is an average from European data:

ASH COMPOSITION OF CAÑAIGRE ROOT.

	Cañaigre.	Sugar Beet.
Silica (SiO_2)	3.89	3.50
Potash (K_2O)	28.74	49.40
Soda (Na_2O)	2.47	9.60
Lime (CaO)	8.16	6.30
Magnesia (MgO)	16.93	8.90
Br. ox. manganese (Mn_3O_4)	.98	----------
Peroxid of iron and alumina	2.45	1.10
Phosphoric acid (P_2O_5)	18.19	14.30
Sulphuric acid (SO_3)	13.16	4.70
Chlorine	6.43	2.60
	101.40	100.40
Excess of oxygen due to chlorine	1.40	.57
Totals	100.00	99.83
Percentage of pure ash in dry root	4.48	4.35
Percentage of crude ash in dry root	4.79	5.44
Percentage of carbonic acid in crude ash	5.20	20.00
Percentage of total nitrogen in dry root	1.93	.87

A partial analysis reported from the Arizona station, while confirming the greater demand for phosphoric acid by cañaigre, as compared with the sugar beet, assigns to the former twice as much potash as to the latter, and does not mention either soda or magnesia. While such differences are not unexampled, these data can hardly be accepted as proving them in this case. Roughly speaking, we are probably justified in assuming that for equal weights of crop the cost of replacing the mineral soil-ingredients by the purchase of fertilizers, when necessary, will be about the same for both crops; while, as regards nitrogen, our determination shows that the cañaigre draws nearly twice as heavily as the beet, so that a crop of ten tons of fresh roots will take out of the soil nearly one hundred pounds of nitrogen per acre. In regular culture it should, therefore, probably be alternated with leguminous crops, that enrich the soil in nitrogen.

NOTES ON CAÑAIGRE EXAMINATION.

By George E. Colby.

Results of a Practical Test of Extracting Tanning Material from Cañaigre.—The roots used for this experiment were grown on the University Experiment Grounds, Berkeley, and showed, for the fresh root, 9.27 per cent of tannin. Two kilograms (4.4 pounds) of roots were finely ground, and repeatedly pressed, and extracted with water warmed to 132° Fahr. The liquid extract was strained through fine linen to remove the fine-grained starch, evaporated, and the extract finally dried at 132° Fahr. The yield of dried extract from the above 4.4 pounds was 8.3 ounces, being about 7 ounces of perfectly dry matter, as the air-dried contains 12.5 per cent of moisture. Of the air-dried extract, nearly all is soluble in warm water; and it contains 75.02 per cent of tannin, or tanning material. The "spent" cañaigre, from which the above tannin had been extracted, was then examined, to see how much tannin remained behind from the water treatment. It was found that an amount equivalent to a little more than one per cent (1.25 per cent) of the original fresh root had remained undissolved. Or, in other words, the fresh roots, containing 9.27 per cent of tannin, yield, by this method of extraction, but 86.6 per cent of its total tannin; thus involving a loss of 13.4 per cent.

Results of Analyses of Samples of Cañaigre by Different Methods.
(Figures represent percentages upon air-dried substance.)

Place of Production.	Method.		
	Hide-Powder.	Gelatine.	Neubauer-Lowenthal, or Permanganate.
California, Kern County		30.00	30.70
California, Kern County		17.50	17.43
Arizona	23.51	23.50	23.65
Arizona	19.50		19.80
Arizona	33.50		33.44
Mexico	25.30		25.31

These results are close enough to satisfy any one that the percentage of tannin in the cañaigre root can be pretty safely determined by either of these methods; however, of the two which are practically identical in their nature—the gelatine and hide-powder methods—the latter is preferred by both English and Continental chemists, as giving the most practical test of a tanning material.

VIII. OLIVES.

PICKLING PROCESSES—NOTES ON OLIVE VARIETIES, OIL MACHINERY, CLASSIFICATION OF OILS, ETC.

By Arthur P. Hayne.

PICKLING PROCESS.

In view of the many questions asked us concerning the uses of ripe olives and the methods of pickling them, it is deemed expedient to publish a discussion of this subject. This is especially important, as most olive-growers are not yet familiar with the various methods that have been used in the older countries of the world. The very extensive plantations of olives in all parts of the State are beginning to yield crops which will soon more than supply the local market, which has thus far consumed almost all of the oil and pickles produced in the State. The fact that most of the earlier plantations were on a large scale, and that the owners were enabled to put up their own crops and market them themselves in the immediate neighborhood, has rendered it all the more difficult for the small grower to dispose of his crop of olives to those who are now producing all they can conveniently dispose of to their regular customers.

It is safe to say that the olive market, especially that for ripe pickled olives, has been very badly exploited thus far. Judging from the numerous questions continually asked, the producer does not seem to be able to find the buyer, and the buyer is equally at a loss to find some one who can supply his needs. The wholesale pickle merchants are asking where they can find good ripe California olives, and the small- and large-scale producers are complaining that there is no market for their goods. Many are already discouraged and regret having planted olives. There seems, however, to be no real ground for complaint, for there is apparently an unlimited demand for ripe pickled olives in this country, Canada, and Mexico. What is needed is an organized market. All those who wish to buy olives should know where to get them, and those who have pickles for sale should know where to find a purchaser. At present, there is a greater demand than supply. I am informed by some large wholesale houses that the supply of ripe California pickled olives is usually sold within three months from the time of the harvest, and that while the local supply lasts, there is little sale for Spanish and other imported olives; also, that the California article is sold higher than the imported one. The supply in the eastern part of the United States comes almost wholly from abroad, though a few carloads have been recently shipped to Chicago and other points East.

It would seem that with proper handling the market for ripe pickled olives is as yet unlimited. Thus far, few people know of their great value as an article of food; consumers have been accustomed to the imported green pickled olive that is fit only for a relish, and few among them have ever thought of making olives a part of their food for nourishment. The obvious reason is that the *green* pickle is indigestible, while the *ripe* pickled olive is one of the most wholesome foods known. There is as much difference between the wholesomeness of a ripe pickled olive and a green one, as between ripe and green apricots. Whole populations in the Old World use olives as a substitute for meat, and in America the demand, even for the green fruit as a relish, is far greater than is generally imagined. The delicious flavor and great nourishing value of ripe olives, as well as the wonderful adaptation of California for olive-growing, marks this crop as one of the most important of the future. Those who can make and handle their own oil will rarely be at a loss to find a paying market, if they put up a carefully made article; a poorly made oil or pickle, on the contrary, is worse than valueless.

Investigation of the complaints heard from many quarters that there is no market for ripe olives, and that the pickle merchants refuse to buy them, will usually show that the reason why merchants refuse to handle the lots in question is simply because of their being so badly put up that the merchant would have suffered heavy loss from spoiling. It is a mistake to suppose that ripe olives will keep but three months, for it is certainly a fact that a properly pickled olive will keep for many years. This has been demonstrated in this State as well as in the Old World. Professor Hilgard, of the College of Agriculture of the State University, has used olives which he put up three years before, and found them as delicious an article of food as one could desire.

The process of pickling the ripe olive seems so very simple at first glance, that the grower frequently works in such a careless way that nothing but failure can result. The common belief seems to be that there is an invariable rule by which all olives can be treated; that the element of common sense can be eliminated from the problem, and the slip-shod procedure commonly called "more-or-less method" can be practiced with impunity. It is to show that the process of pickling the olive is one of the most delicate of the agricultural arts that this article is written. So many complicating circumstances enter into the problem, requiring the exercise of so much close observation and judgment, that all the Experiment Station can do is to indicate the general lines of procedure, and warn the beginner against common errors.

Objects to be Attained in Pickling.—The two great objects to be attained by the process of pickling are: First, to remove measurably the "bitterness" (more properly tartness) of the fruit and make it agreeable to the taste; second, to preserve it so that it can be used at some future time without the loss of any of its good qualities.

It must be remembered that the olive contains a considerable amount of vegetable acids and an acrid substance called "olivil." It is a mistake to attribute the "bitterness" of the olive to tannic acid. While there is a considerable quantity of tannin in the olive, it is not this that causes the trouble. Olivil has been little studied in this connection by chemists; but we know that it is readily soluble in water and can be neutralized by soda and potash.

The quantity of this acrid principle varies according to the *variety, soil, climate, and state of maturity*, and even from season to season, other things being equal. It is owing to this fact, *i. e., variation of the degree of acridity*, that we are unable to make hard-and-fast rules that will fit all cases. It is certain, however, that we must never sacrifice the keeping qualities of the olive to the mere removal of the "bitterness." Better have a slightly tart pickle than one that is perfectly neutral and will not keep. This naturally brings up the question of the amount of "bitterness" that should be left in the pickle. The public taste is not at all uniform in this regard, some desiring the olives to be perfectly neutral, while others will not be satisfied unless there is a very decided tartness remaining. As the taste for pickled olives is to a certain degree a cultivated one, it would be well, perhaps, to set the standard from the first so as to require that all ripe pickles shall have a certain amount of tartness remaining, as this is not only healthful, but conduces to the keeping qualities of the pickle.

The acrid principle is in solution in the juice of the olive, which is evenly distributed throughout the flesh-cells. It can be removed either by the action of pure water, or by the combined use of lye and water. In either case the water, or the lye and water, act by "diffusion." The water alone acts upon the uncombined acid and acrid principles very slowly, on account of the compactness of the flesh- and skin-cells, as well as the very slight difference in specific gravity between the two. When lye is used, the soda or potash, or both together, attack the skin as well as the flesh-cells, and render both more porous. They also neutralize the acids and acrid principles, and, combining, render diffusion more rapid.

The great danger in the use of "lye," more especially of soda, is that it is so caustic that the tissues of the olive are softened and to a certain extent disintegrated, thus making it a fertile field for the growth of innumerable micro-organisms that rapidly cause the fruit to become unfit for use. Aside from this softening effect, strong lye will saponify a certain amount of the oil in the olive, and thus take away a certain proportion of its nourishing value. This loss was found by Mr. Colby to be about 3 per cent of the entire oil-content.

Fungous and Bacterial Growths.—It should be remembered that a "spoilt" olive is merely one that has been decomposed by bacteria and other micro-organisms, which as a rule are harmless to the human system, yet are none the less fatal to the taste and structure of the olive. It is almost impossible to preserve a soft olive without the use of strong antiseptics, a practice that cannot be recommended, except in rare cases. It is for this reason that such great stress is always laid on the importance of never bruising the fruit either during the picking or handling of the crop. Frozen olives are worse than even the bruised fruit, for they are really more broken and injured than those bruised mechanically. The presence of a few soft olives, acting as a breeding-place for numberless micro-organisms, serve in a short time to infect the entire lot with disease, and speedily bring about the ruin of the entire vat or barrel. Moulds or fungi are not, as a rule, as dangerous as the smaller bacteria.

Most of the fungi are found to develop at the surface of the liquid in which the olives are being treated or preserved, and there is little danger if the latter be well covered with liquid and the floating cover kept clean. If a floating mould be allowed to sink to the lower strata of the liquid the germs do not die, but their attacks are less to be feared than those of the bacteria. The reason is that fungi are, as a rule, dependent upon oxygen of the air for development, while most bacteria are not. Examination of numerous samples of olives that had been badly pickled, or that had "gone wrong" during the process of curing, showed that the liquid in which the olives were kept was full of all sorts of algæ, inactive mycelia of fungi that had been submerged, and more especially a great number of putrid ferments ("*Bacterium termo*," et al.). In some, the lactic and butyric ferments predominated, giving to the whole a characteristic odor. When once a lot of olives has been infected with these micro-organisms it is impossible to restore the original flavor. It is not, as a rule, advisable to resort to the use of antiseptics, for the flavor of the olives will already have been destroyed; moreover, foreign flavors have gained such a firm foothold that it would do very little good to resort to the use of agents that are more or less dangerous to the human system and can at best but stop *further* development of bacteria without correcting the taste.

In preserving olives we must then bend all our energies to prevent the germination and development of these disease germs. One of the most practical methods is to use only pure sterilized water, and never to allow this to stand long enough in contact with the olives to enable the germs to sprout. At ordinary temperatures, and in nutritive media, the bacteria will develop in twenty-four hours. Hence, by using only sterilized water, and changing this at least once in twenty-four hours, little danger need be feared, for by the time the water has become charged with nutritive substances and is capable of developing germs so far as to injure the olives, it is drawn off and gives place to a new supply of sterilized water; the floating cover will measurably prevent the charging of the water with new germs from the air. Ordinary canal water is naturally full of these micro-organisms of all kinds, and is one of the surest means of spoiling the pickles.

The mere fact that the water has been boiled once is no guarantee that it is sterilized. While boiling will kill most of the bacteria to be feared, it will not kill the germs of some of the most harmful, such as the germs of the *Bacterium termo*, or putrid ferment. Hence, water to be thoroughly sterilized should be boiled two or more times at intervals of twenty-four hours. But even when the purest water has been used and is not drawn off and renewed at short intervals, the whole will become infected, as shown above. Moreover, a scum will form at the water-level along the side of the vat. This adheres to the walls of the vat, and, unless carefully scraped or washed off, will act as a breeding-place for the objectionable bacteria, but more especially for fungi.

Effects of Salt.—The foregoing remarks apply to the pure water during the various "soakings" that the olives undergo during their preparation. When salt is added to the water it is to accomplish a twofold object: First, it causes the pores of the skin and the tissues of the flesh to contract, thus rendering the whole flesh firmer. The various soakings in lye or fresh water during the preparatory operations cause the tissues of the olive to relax, and the chief action of the salt is to "harden" the flesh. This is a matter of the greatest importance for the subsequent welfare of the pickle. If, however, the salt be applied in large amounts immediately, the contraction of the tissue is not uniform and occurs chiefly on the outside of the fruit, causing it to "shrivel" and crease. In order to obviate this difficulty the salt is added in very small doses, progressively. The second great object attained by the use of salt in the brine is to prevent the germination of the ever-present bacterial germs, salt being an antiseptic. But it is not powerful enough to kill either the bacteria or their germs, or, indeed, to prevent growth and germination in all cases. It is merely a very unfavorable medium for these micro-organisms; as is shown by the fact that if very strong brine be put on olives that are already far gone with bacteria, these will nevertheless continue to develop and finally spoil the whole. The antiseptic power of salt is, however, sufficient to preserve sound olives for a comparatively long time.

Besides these two important offices of salt, there is another, viz., that of imparting to the fruit a salty or "pickle" taste. Vinegar, spices, etc., are sometimes added to the preserving liquid to give an agreeable flavor. In this country vinegar is used almost entirely for green olives, very seldom for the ripe-pickled fruit. The use of vinegar in the salt brine is objectionable only on account of the taste it imparts, which is not agreeable to many persons.

Use of Caustic Solutions.—There is an error frequently committed in the use of lye, which should receive mention at the very outset. It is that even when lye of the proper prescribed *strength* is used, the *amount* of the solution employed for a given measure of olives is often excessive, and the injury thus done may be as great as if too strong a solution had been used. It should be understood in all cases that the prescription as to time and strength of solution applies to the use of *just enough to cover the fruit and the floating cover that keeps it submerged.* On no other basis can any prescription or practice be made sufficiently definite. Simple and obvious as this may seem, it has but too frequently been neglected, with disastrous results.

Since in the process of extraction, the solution tends to become of unequal density and concentration in its different portions, it is customary to pump the bottom layers of a lye solution to the top repeatedly, in order that the density may be equalized throughout the mass and the effect thus rendered uniform. If this be not carefully attended to, it will be found that some of the olives have been too much attacked by the lye, while others remain bitter; moreover, the upper layer of olives will be found to be spotted, and the keeping qualities injured.

Use of Boiled Water.—Another fact worth remembering in the handling of olives is that the boiling of water expels all the air that has been absorbed. Ordinary water will absorb a considerable quantity of air, which is richer in oxygen than the atmospheric air we breathe. This is important, for oxygen is, as a general thing, very favorable for the development of most micro-organisms. As the chief problem is to *prevent* this in the liquids in which the olives are treated or preserved, this gives us a clew that is of considerable value, namely, the use of boiled water. The boiling kills the germs present and expels the oxygen, and thus for a short time makes very difficult the development of any new germs that may fall in the liquid.

This also accentuates the necessity for changing the water frequently in order to prevent the re-absorption of oxygen by the water.

Grading.—It has been found in all branches of fruit culture that it pays well to grade the crop. I need only refer to the experience gained in the case of the citrus fruits, raisins, and all kinds of fresh and dried fruits. One of the greatest dangers that ever menaced the fruit industry is hasty, careless picking and packing. The proof is that those who have made the most money in this industry, are those who have been the most careful in the grading and packing of their fruit, fresh or dried. The olive is no exception to the rule. The greatest care should be taken to pick the crop so as to have a uniform state of maturity; and then it should be carefully graded, especially when intended for pickling. The largest olives can be used for "Queen olives," the second size for the commoner grades, and the very small ones can be disposed of just as well to the oil-maker, for whom the small olive has nearly as much value as the large one of the same variety and locality.

THE OPERATION OF PICKLING.

Preliminary Handling and Selection.

State of Maturity.—The first thing, then, is to determine the proper state of maturity for pickles. This is reached as soon as the oil has completely formed in the drupe. If the olive is picked before it has formed its oil, it will be hard, indigestible, and largely devoid of the nourishment that makes the ripe pickled olive so highly esteemed. If on the other hand the olive is allowed to remain on the tree after the oil has formed, the flesh becomes soft, and the keeping qualities are impaired. Nothing, then, is gained by waiting after the fruit has reached its full "oil-richness," which is the chief quality a ripe pickle should possess. In hot climates the color of the olive at this state of maturity will be lighter than in colder regions; hence the color alone cannot be relied upon to furnish us with a sure guide to the determination of maturity.

When the drupe changes color and feels slightly soft to the touch, and when, upon pressing the juice and allowing it to stand, it is found that some minute globules of oil rise to the surface, it may be said that the olive is ready to be picked, either for oil or pickles. At this time the oil is not only of a better chemical composition and flavor than later, but the liability to bruise and decay is far less.

Handling the Olive.—In the case of olives destined to be made into oil, bruising is conducive to the growth of fungi that ruin the good qualities of the oil. In the case of pickles, the bruised olive develops not only fungi but also innumerable bacteria. The oil-olive is to be kept but a short time and can even be evaporated ; but with the pickled olive it is different. It must be kept a very long time without losing its water of vegetation, and one of the first requisites is that it shall be firm. It is for this reason that all authorities on the subject of oil-making or pickling are unanimous in condemning the custom of beating the olives from the tree with poles, or "combing" them off with rakes or other contrivances. In all cases the olives should be *picked by hand*, and with those destined to be pickled, the greatest care should be taken not to bruise the drupe in the slightest degree.

So important is this, that it is the custom with the best operators to pick the olives into buckets half-filled with water. In pouring them from the buckets or bags, the workmen are in the habit of using a barrel into which they pour the crop as fast as the buckets are filled ; this barrel is half full of water so as to "break the fall." Letting an olive fall from the top of an ordinary barrel and allowing it to strike the hard bottom with full force will bruise the soundest olive, and the chances of making a good pickle out of a soft olive are slight.

Varieties of Olives.—It is to be noted in this connection that some varieties require more care than others. Indeed, there are some, as the Cucco, Polymorpha, Macrocarpa, and in fact all of the very large fleshy olives, that are so delicate that they are used almost entirely for green pickles. It is true that when these large varieties are successfully pickled ripe, they are of the greatest excellence. It might be well to note that the Sevillano is the largest olive we have, and that it is usually pickled green; but its oil-content and wonderful size would make it perhaps the most delicious of pickles, could it be preserved when pickled ripe.

It is a mistake to suppose that there is any one variety known as the "Queen olive." This is a term used to designate any very large olive. It originated with the Sevillano, or olive of Seville, and the Gordal, another of the very large olives grown around Seville. These, however, are two distinct varieties, the Gordal being smaller, and of a different shape from the Sevillano. It is a mistake to follow the nomenclature of certain California nurserymen who have named the Sevillano the "Sevillano-Gordal." While the value of these large olives is certainly very great for pickles, it is to be observed that they are all shy bearers, and are essentially hot-country olives. The difficulty with which they are preserved should caution the planter to be prepared to put them up green, or else he may sacrifice many crops in experimenting with preserving them ripe. While the large, fleshy olives are hard to pickle when ripe, there seems to be considerable difference between some of the smaller varieties in regard to the amount of hard treatment they will bear during the process of pickling. Among the tougher varieties we may mention the Nevadillo Blanco, Mission, Oblonga, etc., which will remain firm under the same treatment which will soften some of the others of equal size.

Color of the Olive.—Thus far most of the ripe pickled olives that have been sold on the market have been Missions that have been allowed to become jet black; hence, the idea has gone abroad that all ripe pickled olives should be black. That this is an error has been sufficiently demonstrated lately. Some olives are naturally light in color, and even the same variety varies greatly in this respect, owing to climatic and soil differences. The only requisite of a ripe pickled olive is that it should contain its full natural oil percentage, for the market does not want a soft olive under any circumstances.

The manner of preserving the olive, also has a great deal to do with the final color of the pickle. A fruit that has been preserved by the lye process has far less color than one that has been water-cured; and soda will take out far more of the coloring matter than the same quantity of potash. Hence it is that the best practitioners use only potash, partly on this account, partly because it softens the flesh of the olive less than the soda does. While the actual color makes but slight difference in the eating value of the pickle, it must be kept in mind that uniformity of color is for the purchaser a very important consideration. This can only be regulated by picking such olives as are of a uniform color.

This is practically a very hard matter. With one accustomed to the use of ripe pickled olives a slight variation in the color is not thought of, but to the beginner any variation from his preconceived ideas of what the color should be is a grave defect. Hence it is that olives that are destined to be put up in bottles should be uniform in this respect. This necessitates two or three pickings, which is no inconsiderable expense. Nevertheless it pays, and pays well, to make a couple of pickings in order to secure this uniformity in general appearance. It is to be noted that there is more uniformity in color after pickling than before.

Grading.—Grading according to size may be done either before extracting the bitterness, or after the olive has been hardened. There are drawbacks in either case. If the fruit is passed over a "grader" before pickling, it is apt to be bruised, thus rendering the pickling more difficult. If the grading according to size is done after the bitterness has been extracted, though there is less danger from bruising, it will be found that there is a lack of uniformity in taste. This is due to the fact that the thickness of the flesh from the skin to the pit is unequal, and that the large olives will have some tartness remaining when the small ones are perfectly neutral in this respect.

It is, therefore, often a very delicate question to decide which of two evils to choose. It would seem that if the crop is naturally rather uniform in size it would be better to pickle first and grade afterwards; but if the crop is very irregular in size when picked it would be better to grade carefully first, and do the pickling afterwards. The danger from bruising while grading can be greatly lessened if the olives are made to fall into water as they pass through the interstices of the grader. This is advisable in either of the above cases.

To Extract the "Bitterness."

Pure-Water Process.—The oldest, and perhaps the best known, method of extracting the tartness from the olive is by simply soaking it in pure water till all the excess of such substances has been extracted. This process, though seemingly very simple, is a very dangerous one to the olive, and requires the greatest patience and care. The reason is that a continued supply of perfectly pure water is hard to command, and that the slightest carelessness in regard to the changing of the water at regular intervals will allow the bacteria to gain a footing in the vats, thus rendering danger from putrefaction very great. As in the case of extraction by lye, the vats should be furnished with false bottoms an inch or so above the regular bottom, so as to allow the impurities to be easily drawn off. The fruit should not be in layers of more than twenty or twenty-five inches in thickness. The water should be the purest well or spring water, and were it possible to have boiled water it would be better. The benefit from using distilled water is incalculable, and on places where there is a steam engine this is possible by condensing the steam that is ordinarily allowed to escape. A condensing apparatus is inexpensive. Under no circumstances should canal or ditch water be used, even for one day. There should be a floating cover that should be kept scrupulously clean; and over this there should be a close-fitting cover to keep out the light, air, and incidentally, all germs of fungi and bacteria.

It is customary in some countries to make an incision in the flesh of the olive with a sharp knife, thus allowing freer access of the water to the flesh. This practice, while greatly expediting matters, cannot be recommended, as it tends to make the life of the pickle shorter, and is too expensive for our conditions. The danger from bacteria and softening is far greater with slit olives than with those with whole skins.

Ordinarily this extraction process lasts from thirty-five to sixty days. The water should be changed once each twelve hours, though some do not change oftener than once in twenty-four hours. Experience has shown that the latter is too long a time for the water to stand in contact with the olives. Once a week the whole vat should be well rinsed by filling and drawing off the water several times, in immediate succession. The length of this fresh-water soaking varies greatly according to the tartness and toughness of the olive. After the first twenty days the fruit should be tasted every day, and when the proper amount of tartness has been extracted, the fruit should be put into a salt brine containing four ounces of good pure salt to the gallon of water. In this they should remain about two days, and if the salt does not seem to penetrate the flesh a fresh brine of the same strength should be put on for two days more, then another brine which contains six ounces of salt per gallon should replace it. This in turn remains about a week, and then is replaced by another brine, which should contain eight or ten ounces of salt to the gallon. After a couple of weeks in this brine, a final brine should be used, containing fourteen ounces per gallon. The olive then is pickled, and can be kept in barrels for three years, the brine being renewed yearly, or as often as it becomes discolored. In making the brine only boiled water should be used, especially in the last brine, when the water should be boiled twice, with an interval of twenty-four hours between each boiling. In all cases the salt and water should be boiled together, and the brine put on cold. All scum should be carefully skimmed off, and impurities should be allowed to settle.

Only well-seasoned wood should be used in making the vats, and this should be well soaked previously with strong boiling sal-soda solution. Many have spoiled fine crops by using unseasoned pine or redwood. If the wood be too strongly imbued with its natural resins, a good precaution is to give the interior of the vat a good hot coating of paraffine, which is tasteless, and is capable of preventing all contact of the water with the wood. The olives should be moved from one vat or vessel to another as seldom as possible.

For fancy olives, spices, cloves, etc., are sometimes inserted into the flesh. This, however, is practiced only in rare cases.

The great advantage of the water process is that the natural taste of the olive is altered but very slightly, and there is no oil lost. The tartness being extracted by diffusion, the oil remains in the flesh, while when lye is used there is a certain amount of oil that will be saponified and thus becoming soluble will be extracted by the water. With all the dangers incident to this process, it must be remembered that it enables the grower, when he is successful, to put on the market a far more delicate and more delicious pickle. The main drawback seems to be that few are willing to spare the time to cure olives in this way. With vats properly arranged, and a good water supply, the work is less than appears at first glance.

Lye Process.—The process of extracting the tartness from the flesh of the olive can be greatly shortened by the use of lye before soaking in fresh water. This method requires fully as much care, but as the time is so short, one must devote all his time to this and never allow anything to call him away from the immediate supervision of the pickling vats. The tartness of the olive is so great that it is impossible to tell otherwise than by actual experiment how long the lye should remain in contact with them; it will not do to take anything for granted. When, however, the bulk of the tartness has been removed, it is possible for the taste to be called on for aid. Then, too, the lye must be kept in constant circulation, the bottom lye being drawn off and poured on the top so as to equalize the density of the whole.

One of the first precautions in using the lye process, is to determine the strength of the lye used. As a chemical laboratory is not at the command of all, it is necessary to use only lye that comes from firms that are well known, and who guarantee what they sell. During the past season of 1894–95, I had occasion to use some concentrated lye in illustrating the various methods of pickling to the class in olive culture at the University of California. Finding that the supply of lye in the laboratory of the College of Agriculture was not sufficient for the purpose, and not having time to send to the firm that usually supplies the University with chemicals, I sent to a neighboring grocery store for what was needed. I was sold some under the name of "Keystone Concentrated Lye." The strength of the best concentrated lye is 98 per cent pure. Not feeling sure of the brand, I submitted two cans to the chemist (Mr. Colby) for analysis. His report showed that one can contained only 16 per cent, and the other 13 per cent pure alkali. When it is considered that this should have been 98 per cent, the imposition thus practiced on the general public is apparent. While any lye guaranteed to be 98 per cent pure will do, care should be taken to see that a proper guarantee is printed on the label. The best olive-picklers use "Greenbank Lye." This has been found by the chemists in the Experiment Station of the University to be almost invariable in strength; hence we feel no hesitation in recommending it. In this case it is safe to calculate on 100 per cent of purity.

As has been said, some use soda "lye," and others only potash. From the experiments conducted in the olive laboratory of the University, as well as from those of the best practitioners, we feel safe in recommending the use of *potash* in preference to *soda*. It was found that for the same strength of lye solution applied to the same kind of olive, and the same length of time, the potash was preferable. Not only does it take out less of the coloring matter, but it softens the flesh of the olive far less. Firmness being one of the chief requisites of a pickled olive, the deduction is apparent.

Strength of Lye Solution.—One of the objects of the series of experiments undertaken this olive season was to attempt to establish the limits within which it was safe to experiment. The "recipes" for curing olives by the lye process make these limits very narrow. By using the same strength of lye (soda and potash respectively) on a number of varieties, we found that these limits had to be extended greatly. While a lye solution of a certain strength would give in a certain time an excellent pickle of one kind of fruit, the same when put the same length of time on another variety, would spoil the whole. The theory of treating with lye is, that the caustic alkali (potash or soda) attacking the tissue of the olive, penetrates very rapidly toward the pit, neutralizes the acrid substances that render the olive unpalatable, and renders diffusion more rapid, owing to the great difference in the density of the water and the dissolved substances, neutralized or otherwise, to be gotten rid of. *When the lye solution is made too strong*, the outer layer of the flesh is too much softened, while the inner layer is not reached at all; or if the lye is left on long enough to reach the inner layers, the outer layers become so soft that the fruit cannot be kept.

All the experiments made tended to show that the stronger the lye solution the greater is the danger from spoiling, because of softening. As the strength of the solution diminished, the firmness of the flesh of the olive increased. Six per cent lye (nearly half a pound to the gallon of water) was the maximum strength experimented with, and in every case the olives were spoiled. Those to suffer the most were the very ripe ones of all varieties; but more especially was it the case with the fleshy kinds, such as the Macrocarpa, Polymorpha, etc. The Mission, even the very large ones, showed the greatest resistance to the attacks of the lye. Some very curious results were obtained with some of the varieties, tending to show that little or no reliance can be placed upon the reports that come from careless experimenters.

While no good results were obtained from the use of the 6 per cent solutions, no matter how short a time the lye was left in contact with the olives, a very small number of good results were obtained by the use of a 5 per cent solution left on for a short time. The best results obtained from *single treatments* was from 4 per cent potash (5 ounces per gallon), left on from eight to twelve hours. It would seem, however, that it is better to use several successive lye treatments, with a solution of low strength.

Olives treated with lye of 2 per cent strength for a few hours at a time until it ceased to render the fingers "soapy," and subsequently renewed until the tartness was sufficiently reduced, gave very good results in many cases. It was found, however, that in the case of green olives the amount of acridity varied as much, if not more, than in the case of ripe olives; so much so, in fact, that it cannot be said that green olives are either more or less refractory than ripe ones. In some cases the green olives were ready for fresh water with one short treatment with a weak lye; while in others they resisted even after being subjected to the lye for more than twice the time.

One of the curious facts developed was that some varieties, by pickling, lose greatly in quantity or volume of flesh. Thus the Lucques, the Oblonga, the Nigerina, and a few others seemed to lose almost one third of their volume during the treatment. It must be noted, however, that those varieties that lose in volume seem to gain materially in firmness.

Removal of the Lye.—The "bitterness" being neutralized in the olive by the application of lye, the proper time being determined only by the closest watching and constant tasting, the olive is ready for the fresh-water treatment; for it must be remembered that while the lye *neutralizes* the acrid substances in the olive, *it does not remove them.* This must be done by the use of fresh water. This is put on the olives after the desired condition of neutrality has been reached. The olives should be carefully rinsed several times with fresh water and then allowed to soak for about twelve hours. This must be repeated at regular intervals; till almost all traces of the lye have been removed. As in the case of the fresh-water process alone, the greatest care must be taken not to allow the water to stand too long or to become "stagnant." What was said in regard to the necessity of using only the purest of water, and changing this every twelve or twenty-four hours, applies with equal force as when no lye is used. When a sufficient time has elapsed to remove all the lye from the fruit, salt is added to "harden" the olive and to preserve it. The subject of the brine treatment has already been touched upon in connection with the fresh-water process.

Method of Pickling Recommended by the Olive-Growers' Association.

One of the most successful picklers of ripe olives, Mr. B. M. Lelong, has given a very good method for treating olives. This will be found in the "Proceedings of the Third Annual Meeting of the Olive-Growers' Association," page 32, which can be had by application to the Secretary of the State Board of Horticulture, Mills Building, San Francisco, Cal.

By reference to that method it will be observed that the question of time of lye treatment and the number of treatments is left to the judgment of the pickler. This is as it should be. I wish to call especial attention to this point, as I have heard of people using this very same process who have wholly misunderstood its meaning in this respect. They insist in relying on the clock and not on their taste.

There are, however, a number of points which require notice and against which I would caution the pickler.

Regarding the bottling of pickles I must differ from the author of the extract just given, as regards the putting-in of the preserving liquid *hot*. I favor the European plan of putting in the boiled brine *cold*. I fail to see any advantage in the use of hot brine. The brine, it must be remembered, has already been sterilized by boiling. In addition to this it has had a strong dose of alum put in, *though the use of alum in foods has been universally condemned by chemists and doctors.* It certainly does act as a "fine" or clarifying agent, but more especially as a powerful antiseptic in preventing the development or germination of germs of fungi and bacteria; and if used at all I cannot appreciate the advantage of putting in the brine hot, when it would act just as well in the cold.

The statement that *"gas" is generated* when the brine is put in hot must also be questioned. In the absence of any definite determination of the existence of gas, or of the kind of gas formed, I must doubt that any is formed. The misleading feature is perhaps the appearance of bubbles when the hot brine is poured on the cold olives. This is due entirely to the escape of air-bubbles from the olives that have been exposed.

Again the statement that *steam is formed* that will preserve the olives from spoiling is liable to cause trouble; for a temperature sufficient to produce steam that will sterilize the air, will also cook the olive. The fact that the brine has already been boiled and hence sterilized, would of itself be almost sufficient to preserve the olives. I would, therefore, recommend that the brine after straining and clarification be allowed to cool before use, and that the cooling take place out of contact with the air.

FURTHER EXPERIMENTS ON CLARIFICATION OF OLIVE OIL.

In the report for the year 1892–93 and part of 1894 some facts were given concerning the clarification of the oil. During the past season, 1894–95, experiments were undertaken to prove the well-known European maxim that an olive oil to be at its best should not be filtered at all, but treated precisely as wine is treated; that is to say, racked off from its dregs as fast as these are formed, till the whole possible deposit is made, and there is no more solid matter left in suspension to deposit. This method is practiced in some of the best oil mills of Europe, and has been proved to be a success, the market price of oil thus treated always being higher than that of the filtered oils, other things being equal.

The idea that the oil should be separated from both the water of vegetation, and all solid matter, being fundamental in oil-making, the use of the "separator," or washing apparatus, described on page 312 of the Report of 1893–94, and reproduced here, is designed to render this separation of the oil from the most objectionable matter immediate.

[The apparatus, as shown in the plate, consists essentially of a tin tank, about four feet high by two in diameter. This tank is kept constantly full of fresh water, by means of a pipe connected with some adequate supply, the level being regulated by means of stopcock outlets.

The juices from the pressing, charged with oil in a finely emulsified state, are made to flow into the tank near the bottom, through a small "drum," perforated laterally. Immediately below this oil-escape is a large flat "drum," perforated on the top, from which a stream of fresh water escapes in vertical jets. These two currents of oil and fresh water at once mix, and the oil passes upward, by reason of its lightness. Being in very small drops, it is washed of its heavier impurities (tissue, coloring matter, etc.), and reaches the top of the column of water in an almost perfectly clean state, having left all grosser impurities to be carried off through an escape pipe at the bottom. When sufficient oil has been collected at the top, a stopcock is opened, and the oil runs off ready to be clarified. The level once established, the apparatus will work uninterruptedly for a long time without being cleaned out.]

There remains, however, a very fine, impalpable mass of vegetable pulp in the oil that can only be gotten rid of by filtration or precipitation. Even if oil be filtered at once, a considerable quantity of this matter remains in the oil after filtration, and a second filtration is necessary. The great objection to filtration of any sort, however, comes from the fact that, as in the case of wine, each time the oil is passed through the paper or cotton batting used, there is considerable loss of aroma and of the more delicate flavors, leaving the oil neutral to the taste, and all the easier to imitate with cotton-seed and other more or less tasteless oils.

It is well established that rancidity of oil comes from two causes: either oxidation or bacteria, or both. It is, then, essential that oil be not unduly exposed to the action of the air either in passing through the filter paper, or by exposure in the tanks.

Some very fine lots of oils have been spoiled in this State from too long exposure to the air while in tanks in a warm climate. The oil will acquire a flavor and taste that remind one of boiled linseed oil. In passing through the filter paper, the surface exposed to the air is multiplied many thousands of times, and thus the oxidation is rendered very rapid.

In the oil-room of the Experiment Station at Berkeley, it was found at first convenient to use a common laboratory separator in order to get

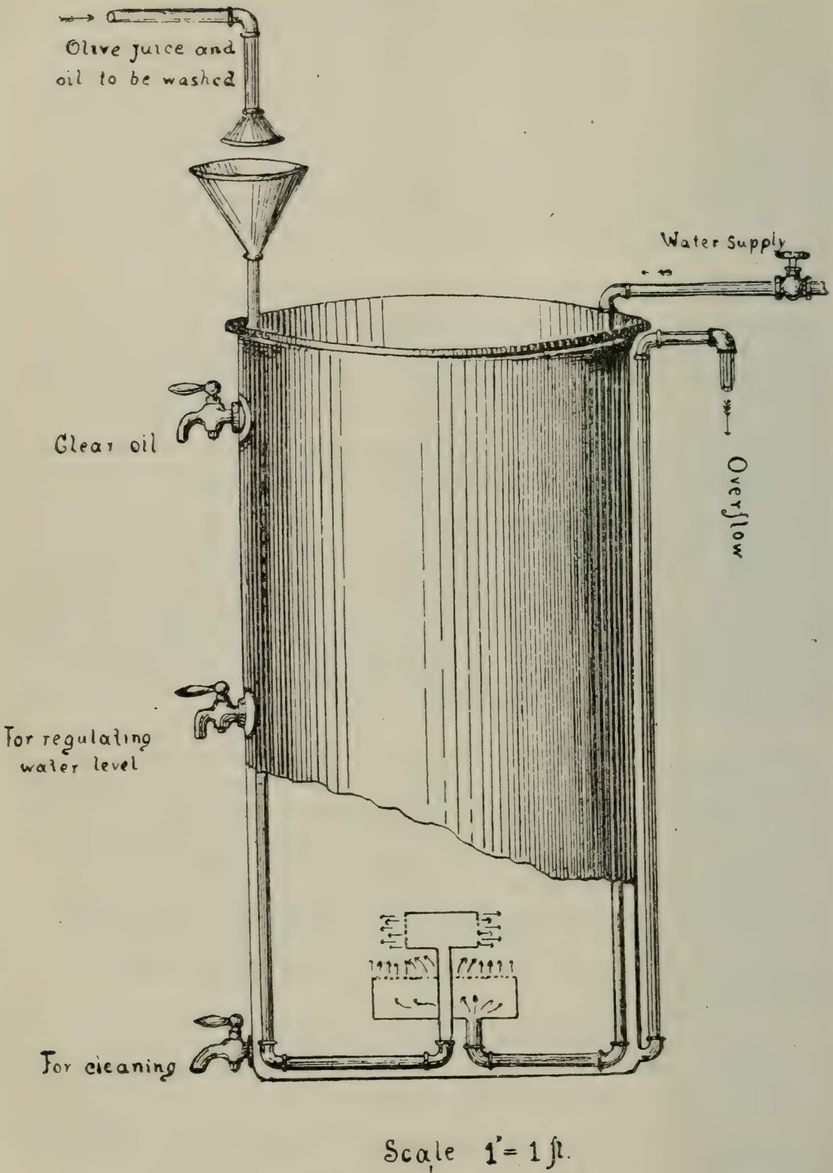

FIG. 1. THE OIL SEPARATOR.

the pure oil as soon as possible. This consisted of a large glass funnel with a glass stopcock at the bottom. As the oil came from the washer or separator (described above) it was at once put into this funnel and allowed to stand over night, taking care to cover the top so as to exclude circulation of air. The following morning the clear oil was on top and the cloudy, thick oil at the bottom of the funnel. This latter was drawn off and only the clear oil remained. The clear oil was allowed to stand

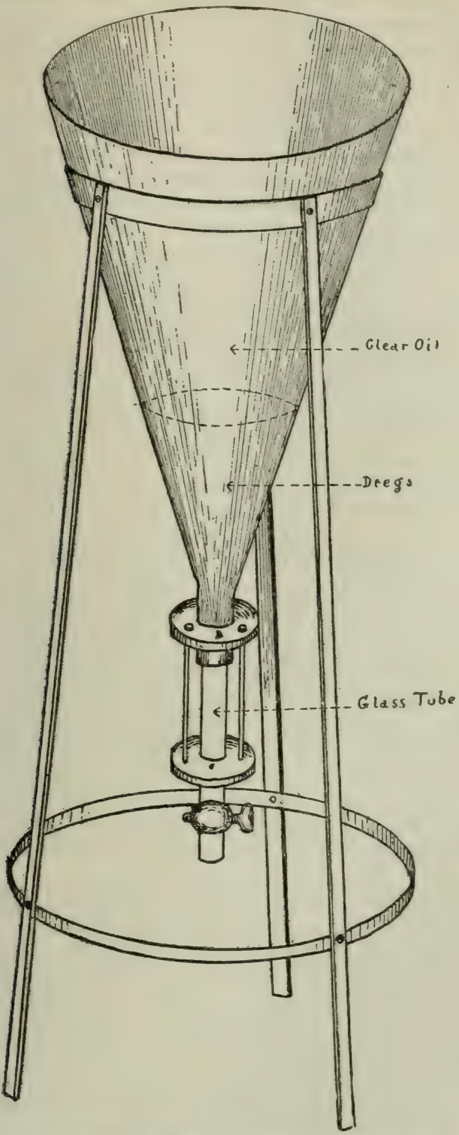

FIG. 2. APPARATUS FOR FINAL SEPARATION OF OIL FROM ITS IMPURITIES.

in a room, kept at a normal temperature, for a month, and then racked; and this racking was repeated till the oil was perfectly clear.

In order to adapt this laboratory method of separation to the scale of an oil mill, a model was obtained through the generosity of Messrs. Toulouse and Delorieux, manufacturers of oil machinery, of San Francisco, who kindly presented it to the Station. This apparatus (see Fig. 2) serves not only for the first separation of the cruder dregs, but also enables one to draw off the dregs as they form.

The apparatus consists essentially of a large tin funnel closed at the top with a tight-fitting cover, the whole being supported a foot or so from the ground by an iron tripod—as is shown in the figure.

The funnel is made of the best tin sheet, the neck at the bottom being an ordinary steam gauge made of glass, with a stopcock at the lower end. Oil coming from the separator or washer (described in the Report for 1892–93, and part of 1894) is poured into the funnel, and after several hours, clear oil only is found at the top, while the bottom part of the apparatus is filled with muddy, greyish dregs, which are drawn off by means of the stopcock at the bottom. The glass tube enables the workman to stop the moment the clear oil comes in sight. In this way there is a great gain in the rapidity of the operation, a great saving of space, and tanks or vessels, as well as avoidance of undue exposure of the oil to the air.

The apparatus can be made of any convenient size. It should be noted that the idea is to have the sides as straight as possible, and the diameter of the top of the funnel not too great. The longer the funnel the better, consistent always with convenience in handling and washing.

This was tried with three samples of oil made from the Uvaria olive, kindly donated by John Rock, of Niles, which had served in illustrating practical oil-making to the University class in olive culture. The oil samples were made from the same lot of olives at the same time, and samples for the experiment were drawn from the same tank at the same time. One was filtered through laboratory filter paper, the best kind used by oil-makers in the State. The second lot was passed through cotton batting, as is done with the majority of oils abroad. The third lot was not filtered at all, but allowed to deposit the sediment; and was racked several times. After six months, examination showed that the oil that had been racked was almost as clear as the filtered oils, and was of a deeper green color, besides having a far more delicate aroma and taste.

In view of these experiments, and in the light of actual practice at some of the best oil-making establishments abroad, I can but recommend the *racking* of oil instead of the California method of filtration. I am aware of the fact that the majority of the California consumers of olive oil require a filtered article, and look with disfavor upon oils with marked tastes or bouquets. But when it is remembered that by filtration and consequent neutralization of olive oil by this process, we are but rendering our oils more easy to imitate, and thus play into the hands of dishonest dealers who adulterate with cotton-seed oil, etc., we think it well worth the effort to educate the taste of the public to the true appreciation of what virgin olive oil really tastes like. The growing adulteration of olive oil by unscrupulous merchants, here and in the East, ought to cause all interested in pure foods, and especially the olive oil-makers themselves, to seize upon every means offered to enable the consumer to have a safer guide than the assurance of his family grocer.

In calling attention to the racking of oils, I think that I show one easy method whereby the public can obtain, not only a better flavored article, but in the end a purer one.

No matter what be the method employed for the separation of the oil from the water of vegetation, it is found that there is always a considerable quantity of oily matter that settles to the bottom of the vessel. This involves double skimming or racking before filtration can take place. By far the greater part of the precipitation of oily dregs takes place during the twelve hours immediately following the skimming of the oil from the water of vegetation that drips from the press. These oily dregs are most refractory, and it has been found that the best way is to put them back into the press well mixed with the oil cake of the second pressing. In order to facilitate the rapid separation of these grosser dregs from the oil, after the latter has been separated from the water of vegetation, ordinary glass funnels, with stoppers at the bottom (such as are used in laboratories), can be used on a small scale, but for large-scale operations the apparatus above described has been designed. The size of course depends upon the scale upon which the oil-maker is working. Owing to the cheapness and simplicity of this apparatus, it is advised to have several, each capable of holding a few gallons, rather than one large one. From practical considerations this will be found the better plan.

WORK IN THE OLIVE LABORATORY.

The work done in the olive laboratory of the Agricultural Experiment Station of the University of California during the season of 1894–95 was on a much larger scale than heretofore. As was the case during the past, the University culture stations were unable, owing to the youth of the trees, to furnish complete lots of samples for analysis or experimentation; but public-spirited growers from all parts of the State made donations that enabled the Central Station at Berkeley to make oil-determinations as well as to undertake certain experiments in oil-making and pickling. Two hundred samples were received from thirty of the leading olive-growing districts of the State. These two hundred samples embraced forty-six of the varieties now grown in the State, and enabled the University to collect extended data, very valuable at this stage of the development of the olive industry.

The entire two hundred samples of this harvest, as well as the ninety odd of the previous years, were analyzed by George E. Colby, Ph.B., Instructor and Assistant Chemist in the Viticultural Laboratory. The method employed by him is the same as is in use in the Department of Agriculture of the United States, as well as in other Experiment Stations. The fresh olives are weighed as soon as they are received, dried, the flesh separated from the pit, triturated in a glass mortar, then washed into a "Soxhlet's extracting apparatus," and all the oil obtained by repeated extraction. The dried, finely ground pit is treated in the same manner.

Sending of Samples.—Here it would be well to call attention to the fact that in all cases where analyses are made in laboratories *perfect* *honesty on the part of the sender is presupposed.* A sample is supposed to be a fair average specimen of the whole crop. The College of Agriculture cannot send some one to each orchard to see that the samples are fairly taken. As the growers have nothing to gain by making false statements, and as they are all presumed to be actuated by a sincere desire to know the truth concerning their own and their neighbors' crops, it is not unfair to presume that they are telling the truth.

Some do object that a few pounds is not a sufficient quantity by which to judge a crop of many tons. This is an error. So long as the samples are honestly taken to represent the average, there is no ground for objecting to the scale on which the analysis is made. Attention is called to the fact that in beet-sugar factories, thousands of tons of beets are received, and samples are taken out of each lot, and thousands of dollars change hands, on analyses made with but a few cubic centimeters of the juice taken from a few beets. The liability to error is far less in the case of olives. Dishonesty on the part of the sample-taker will, of course, destroy the value of the results of any investigation.

It is also an error to imagine that samples of olives taken late in the season are not just as valuable *for oil analysis* as those taken earlier, *always provided*, that the olives have not been bruised or have become shriveled or decayed. Even after a crop has been harvested, and the sample is picked from those olives that escaped the eyes of the picker, the only effect would be on the *size* of the olive, not at all on the quantity of oil; which has been proved to remain constant from the time the olives turn a deep wine red.

It is to be hoped that in the future, olive-growers will send in their samples more promptly. Few realize the burden thrown on the staff of the College of Agriculture in having to write several hundreds of letters at the busiest time of the year. The growers have been informed that we are anxious to receive a pound-and-a-half sample, at least, of each variety from every orchard in the State; also, that the Experiment Station will pay expressage on such samples of each variety, if addressed to the "University of California Agricultural Experiment Station, East Berkeley." Yet it has actually cost about three letters to get each sample. Even then some of the largest growers failed to take the trouble of picking a few pounds of olives and shipping them.

Data Wanted.—It is further urged that all olive-growers send to the Central Station at Berkeley *data* concerning the number of trees planted, and especially the varieties cultivated, with other data that may seem to be of interest. All new diseases should be noted, and the Central Station notified at once, so that proper investigation may be made without delay. The State of California is too large to make it possible for the person in charge of olive culture at the University to keep thoroughly posted as to the development of diseases, etc., without the hearty coöperation of the olive-growers in this respect.

On the whole, nevertheless, the responses received were encouraging. From 1890 to 1894 but ninety-five samples were received from the various parts of the State. During the season of 1894–95 two hundred samples were received. It is hoped that next year there will be six hundred samples. Those who sent olives in the past must not give up so doing; on the contrary, it is of the greatest practical importance to have samples for several consecutive years from the same orchard, so that the (sometimes very great) variations in size and oil-content may be noted and properly studied.

Inferiority of Fruit.—One of the most striking results obtained from the experimental investigations was the fact that the season of 1894–95 was a poor one for olives, both as regards size of fruit and richness in oil. Reports from the various regions of the State show that the trees did not anywhere do as well as usual. This may be in part accounted for by the unusually dry season, as well as by the unfavorable distribution of the rains. In some localities the olives were so much affected by the dryness that the crops did not pay for the picking. Even where irrigation was resorted to, the crops were not up to the usual standard of excellence. This may be accounted for by supposing that the unusual dryness was not properly appreciated, and irrigation was not practiced in time to give the trees and fruit a proper start. Be the causes what they may, it is noted that the averages of both size and oil-richness of this year's crop fall, in most cases, below the averages for the five preceding years. While the size of the fruit will be modified by the dryness of the season, many suppose that the oil per cent should not vary in the same manner. That it does is, I think, due to the fact that no abnormally developed olive can be expected to function normally. While it is certainly true that the oil is formed from elements taken from the air, and not from the soil, it must be borne in mind that these elements must be assimilated and elaborated in the tissues of the leaves and in the flesh of the drupe. If these be in an abnormal condition through disease or drought, less of the desirable elements will be utilized.

NEW VARIETIES OF OLIVES RECEIVED.

Among the many new varieties received at the Central Station this year, we may mention the "*Sevillano*," "*Gordal*," "*Picholine*," "*Picholine de St. Chamas*" (identical), "*Verdale*," "*Ascolano*," "*Ascoli*," "*Cucco*," "*Pleureur de Grasse*," "*Obliza*," "*Solanequo*," "*Santa Caterina*," "*Huff's Spanish*," "*Dalmatian*," "*Leccino*," "*Lavagnino*," "*Morinello*," "*Macrocarpa*," "*Olea Maria*," "*Morchiaio*," and "*Salonica*." Most of these have already been described in the previous report (1892–94), but some among them have not, and owing to the general interest manifested in certain of these varieties, we give the following brief descriptions, taken from the excellent work of Don José de Hidalgo Tablada, who is without doubt the best authority on olive varieties of Spain. It is to be regretted, however, that all the authorities are not as definite as could be wished. So much is usually taken from the works of others without personal verification, that it is impossible to rely upon them for those varieties that have not been under their actual observation. This is especially true as regards synonyms. For their local varieties their work is, of course, exact and valuable, but when they begin to identify these with foreign varieties, we must be extremely cautious before we accept their conclusions. We give their synonyms for what they are worth, observing that few are reliable. In making this statement it should be understood to apply to all authors, regardless of nationality, American as well as European.

Sevillano Olive.

SYNONYMS: *Olivo Sevillano Gordal, Olea Europea Regalis* (Clemente), *Hispanica* (Rocier*), *Pruneau de Catignan, L'Espagnole, Plant de Figuières, Olea Espanica* (De Roz*).

Tree is generally small, which is not the case with any other variety called Gordal. (*See following description of Gordal.*) The *branches* are erect, inclined only from the weight of the crop; *wood* shiny green, with smooth bark; *leaves* lance-shaped, as seen in the accompanying figure; *superior surface* deep green; *inferior surface* greenish white; *nerves* not prominent; *drupe* large, not usually one-sided.

The Sevillano is one of the largest olives known to us. Tablada says that he has seen them as large as 8 fruits to the 100 grams. When ripe the flesh adheres to the pit. It is then of a bluish-black color. This variety is used entirely for green pickling. It yields a small quantity of oil of a deep yellow color. It is quite a regular bearer. The Sevillano thrives in deep, rich, well-drained soils and will not stand much cold. Nor will it stand heavy pruning, especially in wet soils. By referring to the table it will be seen that in California the Sevillano is larger than in Spain, there being an average of 6 to the 100 grams, to 8 as an exception in its native country.

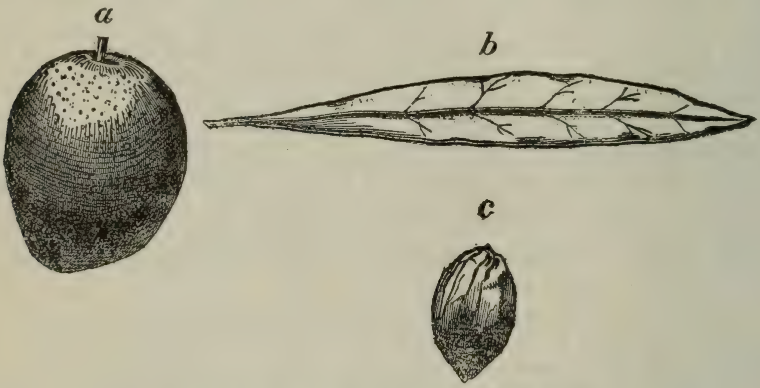

FIG. 3. SEVILLANO. *a*, fruit; *b*, leaf; *c*, pit.

Gordal Olive.

SYNONYMS: *Ocal, Olivo Real, Olea Regia* (Rozier), *Olea Europea Hispalensis* (Clemente).

Tree large and vigorous; is perhaps one of the olive varieties that grows largest; strong and vigorous, shiny branches that grow obliquely; a very fine looking tree; is little attacked by insects, and rapidly heals any injuries or cuts made in pruning. The *leaves* are lance-shaped, as seen in the figure; *superior surface* is dull green; *inferior surface* clear white; *veins* are well marked. The form of the *drupe* is shown in the figure.

The Gordal differs in form from the Sevillano as shown in the figure in being larger on one side than the other. The drupe is much smaller than that of the Sevillano, being about 25 to 100 grams (a trifle larger

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*Probably *Rozier.*

than our Mission). Is highly esteemed for pickles, but yields a good quantity of fine oil. Ripens early; is quite resistant to the cold. This variety is one of the most widely known in Spain. Like the Sevillano, it likes rich, deep, well-drained soil, and responds well to kind treatment. Requires heavy, regular pruning.

The cut below is taken from the work of Tablada. It will be noted that the Gordal is not symmetrical, but one side is much larger than the other. In the case of the Sevillano this is not the case at all, both sides being the same. Besides this difference in shape, the Sevillano is from two to six times larger than the Gordal, the latter being about the size of a good-sized Mission.

From the foregoing descriptions it will be seen that the name "Sevillano-Gordal," that is given by many Californians to a large variety of olive, is erroneous. Two distinct varieties are thus confused. This is but one case in a great many, and it should make us very cautious about jumping at conclusions concerning the identification of varieties we may be growing. I called special attention to this on several occasions, and it seems that many have not understood the point. Of course when we have a complete botanical description, we are at liberty to identify the variety, and to take the most likely synonymn we find. But what I insist on is, that on importing a variety under a certain name, we should not accept this name unconditionally merely because it was so marked. Nor should we identify it with some variety we may already have, merely because among the synonymns there happens to be one in common. While this may seem self-evident, it is certain that a great part of the confusion now existing in our nomenclature is due to this alone. The "Regalis," for example, is, in this State, a very general name, yet I venture to say that there are at least half a dozen distinct varieties sold under that name. There is nothing so common as the *Olea regia* or *O. regalis* in the synonomy of all languages. Close study of the varieties thus named in other countries will show wide differences. Hence we are left in entire uncertainty as to the identity of the original Regalis.

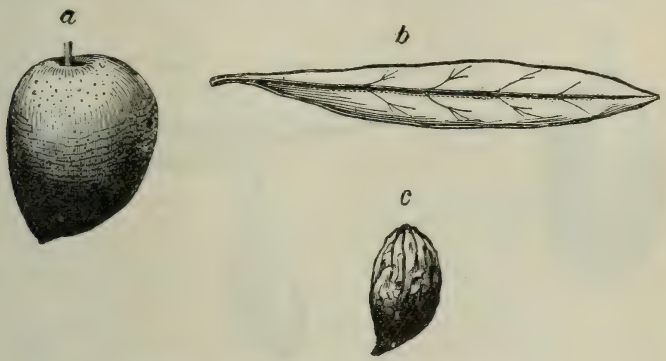

FIG. 4. GORDAL. *a*, fruit; *b*, leaf; *c*, pit.

We can, however, call the most common variety bearing this name here "Regalis," and *re-name* the others. While this is certainly unscientific and will lead to a certain amount of confusion, yet it would seem to be the lesser evil, especially if we make up our minds to cut loose from the European nomenclature. Some supposed that the Regalis is identical with the Sevillano; it may be so in Spain, but certainly is not in California. At least two of the noted importers of olives—John Rock, of Niles, and J. Loop, of Pomona—have authentic specimens that we have verified and found to be the true Sevillano. We are still uncertain of the existence of the Gordal proper in California. It is a fine oil olive and deserves a place in our orchards.

Empeltre Olive.

The Empeltre is another variety that is certainly mis-named in many cases. We call attention to the description given on page 290 of the report for 1892–94, of the distinctive characteristic of this variety; namely, its *dwarfish habit*. The so-called "Empeltres" we have seen were the most vigorous trees imaginable.

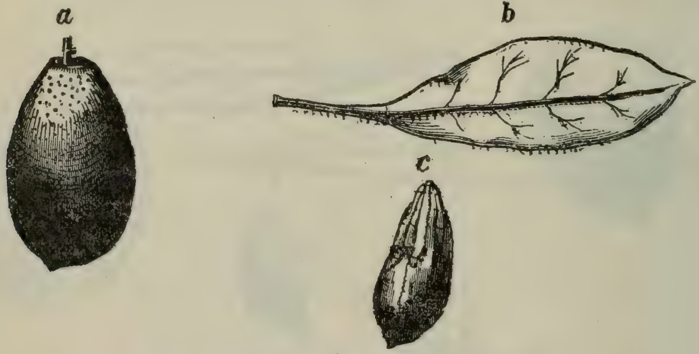

Fig. 5. Empeltre. *a*, fruit; *b*, leaf; *c*, pit.

Huff's Spanish.

This is another variety concerning which we are being asked a great many questions. It was imported as being a very large pickling variety. Others claim that it is *par excellence* an oil olive. The samples we have seen would lead us to believe that it is more on the style of the once famous Redding Picholine, from which such great results were expected. We are free to confess that we do not know as yet what kind of an olive "Huff's Spanish" is. We hope that those who have this variety, or any of the new varieties, will send samples to the Experiment Station for identification.

Olea Maria Olive.

Among the new varieties received we may mention the *Olea Maria*, imported from Southern France by Dr. F. Gould, of Montecito, Santa Barbara County. This variety is peculiar for its bearing on wood of the same year, the general rule being that olives bear only on two-year-old wood. It seems to be a heavy bearer, and in a good year might be high in oil-content.

It is to be noted that the Italian oil varieties have in the main come up to the expectations of the public. For those contemplating olive planting for oil alone, these varieties should be very valuable. Those who have a well-drained soil should give special attention to the Razzo, not merely because of its high oil-content, but for the very high-grade oil for which it is noted.

OLIVE NOMENCLATURE.

The introduction of numerous foreign varieties of olives into California has, as already noted, given rise to not a little confusion in nomenclature. Aside from cases of mistaken identity, the names are spelled in a great many different ways. The result has been that the Experiment Station at the University has been constantly called on for the "correct spelling." This is more epecially true in regard to the Italian varieties, that are daily growing in the estimation of the general public of this State. Perhaps the commonest difficulty arises from the use of the final "*o*," "*a*," and "*e*" by Italians in referring to these varieties. These differences in spelling are due to grammatical rules of construction in Italian, and when used while speaking that language have their proper place. There is, however, no such place for them in English, and it seems wise to anglicize them. In the following list we have preferred the use of the masculine singular form wherever there is diversity of usage. The "*a*" ending is the feminine singular, and in this case refers to the drupe or is an adjective construction referring to "*varietà*," expressed or understood. The "*e*" termination is the *feminine plural* used adjectively, as we would say "Missions," etc. The mere fact that Italians use these forms should not influence English speaking people to adopt them blindly. Thus in speaking of the Tuscan variety "Razzo" we should never refer to it as "Razza" or "Razze." The only apparent exceptions will be in the case of varieties named after persons or localities; in such cases there may be seeming exceptions. It is hoped that nurserymen will correct accordingly any errors that may have crept into their catalogues.

The following is a partial list of well-known olives, the names of which are sometimes misspelled:

Amellau
Ascolano
Ascoli
Atrorubens
Atroviolacea
Attica
Belmonte
Bella di Spagna
Bellotudo
Bozzòlo
Bianchetta
Carrasqueño
Casalivo
Cayon
Champion
Colchonudo
Columbaro
Columbella
Correggiolo
Cornicabra
Cucco
Dalmatian
Dolce
Empeltre
Favarol
Frantojo
Gargnan
Gentile
Giogliaio
Gordal
Gremignolo
Grossajo
Hervaza
Huff's Spanish
Infrantojo
Javaluno (j=h)
Lavagnino
Leccino
Lucques
Macrocarpa
Madrileño
Manzanillo
Mammolese
Marcherito
Maremmano
Mignolo
Mission
Monopolese
Morchiaio
Morajolo
Morinello
Mortino
Mortellino
Nevadillo Blanco
Nevadillo Nero
Nigerina
Nigretta
Nocillara
Oblonga
Obliza
Occhino
Ogliaro
Oleastro
Olivastro
Oriolo
Palono
Palazzriolo
Palombino
Patronese
Pendulina
Pendoulier
Perugino
Pesciatino
Piangente
Picudo
Pilloro
Picholine
Pignolo
Pocio
Praecox
Puntarolo
Racimal
Raciuoppe
Ragghio
Ragialo
Rastrellino
Razzo
Redding Picholine
Redondillo
Regalis
Rossellino
Rubra
Salvatico
Salonica
San Agostino
Santa Caterina
Selvatico
Sevillano
Taggiasco
Trillo
Tondo
Uvaria
Varal Blanco
Verdale
Verdejo

RESULTS OF ANALYSES OF OLIVES.

Received from 1890 to 1895.

By George E. Colby.

The exceptional season that has just passed makes it unwise to consider in special tabular form the differences in the oil yield of the same varieties from different localities, as was done last year. It is deemed best to leave this to the reader, rather than to publish a table that might lead to misapprehension on the part of some. Each grower will have his own special lesson to learn from the tables, and it has been found that the most benefit has been derived by forcing the growers to study the tables for themselves, rather than to give them tables with the comparison already made out. There seems to be a tendency on the part of many to accept without reservation the conclusions drawn by the analyst, no matter how expressly we may point out the provisional nature of the work, or however we may call attention to the reservations made.

In giving the results of analyses as received from the chemist, we furnish data for study, feeling the impossibility of drawing hard and fast rules from them that will fit all cases. Table 2 shows the *maximum*, *minimum*, and *averages* of those varieties of which a sufficient number of samples were received. Where but a few samples were received it was not deemed expedient to attempt to average them. The reader is asked to place more reliance on Table 1 than on the table of averages, as the latter is too general to be as instructive as the larger, though more detailed, data found in Table 1.

TABLE 1.—Partial Analyses of some Samples of California Olives.
(Crops of 1890–95.)

Number	Locality.	Date of Picking.	No. of Olives in 100 grams	1 Proportion of Pits and Flesh in Fruits.		2 Percentage of Oil in Whole Fruit Possibly Yielded by		3 Percentage of Oil Contained in Fresh	
				Pits.	Flesh.	Pits.	Flesh.	Pits.	Flesh.
	Mission Olive.								
12	Mission San José	Jan. 8, 1891	------	23.50	76.50	.94	19.07	4.00	24.90
23	Newcastle	Mar. 9, 1891	------	20.00	80.00	.61	16.55	3.07	20.68
24	Mission San José	Dec. 16, 1891	------	16.50	83.50	.40	18.72	2.40	21.40
25	Fresno	Jan. 12, 1892	------	18.00	82.00	.70	23.08	3.70	28.15
26	Newcastle	Jan. 14, 1892	------	17.50	82.50	.50	17.50	3.20	21.31
42	Mission San José	Dec. 5, 1893	47.00	25.00	75.00	------	16.45	------	21.90
43	Mission San José	Dec. 5, 1893	42.00	26.00	74.00	------	15.31	------	20.00
53	Biggs	Dec. 11, 1893	26.00	17.00	83.00	------	17.78	------	21.40
62	Livermore	Dec. 15, 1893	34.00	25.00	75.00	------	22.73	------	30.29
63	Chico	Dec. 21, 1893	17.00	15.00	85.00	------	20.75	------	24.40
71	El Quito	Dec. 22, 1893	34.00	22.00	78.00	------	15.01	------	19.20
79	Pomona	Dec. 26, 1893	20.00	15.00	85.00	.52	19.46	3.50	22.90
87	St. Helena	Dec. 28, 1893	22.00	15.00	85.00	------	18.70	------	22.00
132	Byron	Nov. 14, 1894	13.00	15.00	85.00	------	16.60	------	19.52
140	Whittier	Nov. 17, 1894	24.00	17.00	83.00	------	18.25	------	22.00
148	Fresno	Nov. 19, 1894	22.00	15.00	85.00	------	19.50	------	22.93
152	San Diego	Nov. 22, 1894	24.00	16.00	84.00	------	19.50	------	23.21
153	Amador	Nov. 22, 1894	22.00	18.00	82.00	------	18.25	------	22.25
155	Los Angeles	Nov. 23, 1894	17.00	15.00	85.00	------	14.65	------	17.23
158	San Fernando	Nov. 26, 1894	16.00	15.00	85.00	------	15.75	------	18.52
160	Los Angeles	Dec. 3, 1894	26.00	16.00	84.00	------	19.10	------	22.73
162	Tulare	Dec. 3, 1894	20.00	20.00	80.00	------	12.00	------	15.00

TABLE 1.—Partial Analyses of some Samples of California Olives.
(Crops of 1890–95)—Continued.

Number	Locality.	Date of Picking.	No. of Olives in 100 grams	1 Proportion of Pits and Flesh in Fruits.		2 Percentage of Oil in Whole Fruit Possibly Yielded by		3 Percentage of Oil Contained in Fresh	
				Pits.	Flesh.	Pits.	Flesh.	Pits.	Flesh.
	Mission Olive—Cont'd.								
165	Concord	Dec. 3, 1894	23.00	17.00	83.00	------	19.00	------	22.88
170	Ontario	Dec. 6, 1894	22.00	15.00	85.00	------	18.75	------	22.05
173	San Diego	Dec. 12, 1894	26.00	15.00	85.00	------	17.15	------	20.18
175	Madera	Dec. 13, 1894	30.00	16.00	84.00	------	20.20	------	24.05
176	Fresno County	Dec. 14, 1894	37.00	20.00	80.00	------	16.55	------	20.69
177	San Diego	Dec. 17, 1894	17.00	14.00	86.00	------	15.35	------	17.84
178	San Diego	Dec. 17, 1894	19.00	13.00	87.00	------	18.50	------	21.26
195	Piru City	Dec. 28, 1894	20.00	17.00	83.00	------	20.75	------	25.00
200	El Cajon	Dec. 31, 1894	21.00	16.00	84.00	------	17.25	------	20.53
201	El Cajon	Dec. 31, 1894	32.00	15.00	85.00	------	12.75	------	15.00
202	El Cajon	Dec. 31, 1894	20.00	16.00	84.00	------	13.94	------	16.54
206	Danville	Dec. 31, 1894	24.00	18.00	82.00	------	19.20	------	23.41
232	Biggs	Jan. 4, 1895	34.00	18.00	82.00	------	18.75	------	22.86
256	Pasadena	Jan. 14, 1895	47.00	19.00	81.00	------	21.75	------	26.85
263	El Quito	Jan. 14, 1895	31.00	20.00	80.00	------	15.00	------	18.75
265	Hemet	Jan. 16, 1895	25.00	16.00	84.00	------	19.55	------	23.27
267	Santa Ynez	Jan. 22, 1895	25.00	20.00	80.00	------	18.55	------	23.18
271	Carpinteria	Jan. 22, 1895	35.00	20.00	80.00	------	16.80	------	21.00
275	San Dimas	Jan. 24, 1895	23.00	15.00	85.00	------	18.50	------	21.81
277	Whittier	Jan. 28, 1895	25.00	16.00	84.00	------	18.00	-----	21.43
278	Pomona	Jan. 28, 1895	19.00	15.00	85.00	------	21.00	-----	24.70
282	Modesto	Feb. 1, 1895	29.00	20.00	80.00	------	25.85	------	32.31
287	Merced	Feb. 4, 1895	25.00	15.00	85.00	------	14.75	------	17.36
	Average, 1894–95	----------------	24.80	16.70	83.30	------	17.20	------	21.45
	Average, 1891–95	----------------	27.53	18.15	81.70	------	17.99	------	22.19
	Manzanillo Olive.								
1	Fresno	Nov. 4, 1890	------	13.00	87.00	.53	19.23	4.10	22.01
2	Berkeley	Jan. 20, 1891	------	16.00	84.00	.51	21.38	3.20	25.45
27	Pomona	Nov. 13, 1890	16.00	22.50	77.50	.66	15.10	3.00	20.00
40	Mission San José	Dec. 5, 1893	32.00	17.00	83.00	------	20.84	------	25.10
86	Pomona	Dec. 26, 1893	15.00	12.00	88.00	.50	19.60	4.23	22 30
95	Fresno	Oct. 15, 1894	19.00	10.00	90.00	------	16.00	------	17.77
114	-------------------------	Nov. 3, 1894	20.00	13.00	87.00	------	12.15	------	13.96
116	Los Angeles	Nov. 9, 1894	27.00	13.00	87.00	------	16.75	------	19.25
119	Tustin	Nov. 9, 1894	26.00	15.00	85.00	------	15.65	------	18.41
138	Amador	Nov. 15, 1894	22.00	17.00	83.00	------	19.00	------	22.89
159	Whittier	Dec. 3, 1894	19.00	15.00	85.00	------	15.00	------	17.64
164	Concord	Dec. 3, 1894	22.00	12.00	88.00	------	12.75	------	14.47
169	Santa Barbara	Dec. 6, 1894	55.00	20.00	80.00	------	19.35	------	24.18
182	Reedley	Dec. 20, 1894	23.00	12.00	88.00	------	18.00	------	20.45
191	Reedley	Dec. 28, 1894	27.00	15.00	85.00	------	22.45	------	26.41
225	Niles	Jan. 3, 1895	29.00	15.00	85.00	------	16.75	------	19.70
253	Carpinteria	Jan. 11, 1895	27.00	13.00	87.00	------	15.25	------	17.52
	Average, 1894–95	----------------	26.30	14.20	85.80	------	16.60	------	19.35
	Average, 1890–95	----------------	23.70	15.20	84.90	------	17.91	------	20.96
	Nevadillo Blanco Olive.								
6	Fresno	Nov. 4, 1890	------	17.50	82.50	1.60	18.02	6.60	22.00
7	Mission San José	Jan. 7, 1891	------	24.00	76.00	1.06	23.94	4.40	31.50
8	Berkeley	Jan. 7, 1891	------	25.00	75.00	1.05	22.72	4.20	30.30
17	Mission San José	Dec. 16, 1891	------	20.50	79.50	.94	25.65	4.70	32.06
33	Pomona	Nov. 22, 1893	28.00	15.00	85.00	------	19.30	------	22.72
39	Mission San José	Dec. 5, 1893	70.00	25.00	75.00	------	15.35	-----	20.50
58	Biggs	Dec. 11, 1893	30.00	18.00	82.00	------	16 22	------	19.00
64	Chico	Dec. 21, 1893	19.00	18.00	82.00	------	18.98	------	23.15
82	Pomona	Dec. 26, 1893	29.00	17.00	83.00	.75	18.50	4.44	22.30
100	Fresno	Oct. 15, 1894	29.00	15.00	85.00	.58	16.50	3.90	19.41
112	Tulare	Nov. 3, 1894	36.00	18.00	82.00	------	11.25	------	13.71
117	Los Angeles	Nov. 1894	50.00	20.00	80.00	------	20.25	------	25.31

TABLE 1.—PARTIAL ANALYSES OF SOME SAMPLES OF CALIFORNIA OLIVES. (CROPS OF 1890–95)—Continued.

Number	Locality.	Date of Picking.	No. of Olives in 100 grams	1 Proportion of Pits and Flesh in Fruits.		2 Percentage of Oil in Whole Fruit Possibly Yielded by		3 Percentage of Oil Contained in Fresh	
				Pits.	Flesh.	Pits.	Flesh.	Pits.	Flesh.
	Nevadillo Blanco Olive—	Continued.							
118	Tustin	Nov. 9, 1894	36.00	17.00	83.00	------	17.50	------	21.08
122	Piru City	Nov. 12, 1894	37.00	18.00	82.00	------	19.75	------	24.08
135	Amador	Nov. 14, 1894	30.00	15.00	85.00	------	14.30	------	16.82
139	Whittier	Nov. 17, 1894	46.00	19.00	81.00	------	19.25	------	23.76
180	Reedley	Dec. 20. 1894	25.00	14.00	86.00	------	17.15	------	20.00
183	Reedley	Dec. 20, 1894	26.00	13.00	87.00	------	18.20	------	20.90
190	Long Beach	Dec. 24, 1894	51.00	20.00	80.00	------	20.05	------	25.06
192	Reedley	Dec. 28, 1894	29.00	15.00	85.00	------	15.25	------	17.94
193	Reedley	Dec. 28, 1894	36.00	16.00	84.00	------	22.25	------	26.49
223	Niles	Jan. 3, 1895	50.00	22.00	78.00	------	18.85	------	24.17
231	Biggs	Jan. 4, 1895	37.00	18.00	82.00	------	13.30	------	16.09
276	San Dimas	Jan. 22, 1895	33.00	17.00	83.00	------	17.10	------	20.60
283	Modesto	Feb. 1, 1895	40.00	17.00	83.00	------	------	------	------
	Average, 1894–95		37.00	17.10	82.90	------	17.40	------	21.04
	Average, 1890–95		36.00	18.80	81.50	------	18.63	------	22.94
	Rubra Olive.								
13	Fresno	Feb. 5, 1891	------	19.50	80.50	.80	17.69	4.10	21.97
14	Fresno	Jan. 12, 1892	------	15.00	85.00	.80	20.00	5.20	23.53
15	Newcastle	Jan. 14, 1892	------	21.00	79.00	.80	27.57	4.00	34.90
32	Pomona	Nov. 19, 1893	35.00	18.00	82.00	------	17.88	------	21.57
35	Niles	Dec. 7, 1893	38.00	20.00	80.00	------	11.88	------	14.85
46	Biggs	Dec. 11, 1893	42.00	17.00	83.00	------	15.24	------	18.40
72	Biggs	Dec. 23, 1893	42.00	18.00	82.00	------	18.40	------	22.40
73	Biggs	Dec. 23, 1893	47.00	16.00	84.00	------	14.85	------	17.70
83	Pomona	Dec. 26, 1893	41.00	16.00	84.00	.91	21.44	5.70	25.53
145	Fresno	Nov. 19, 1894	24.00	15.00	85.00	------	10.75	------	12.63
166	Concord	Dec. 3, 1894	47.00	20.00	80.00	------	17.00	------	21.25
179	Reedley	Dec. 20, 1894	37.00	17.00	83.00	------	23.15	------	27.89
181	Reedley	Dec. 20, 1894	23.00	17.00	83.00	.71	20.10	4.20	24.21
189	Santa Barbara	Dec. 24, 1894	46.00	17.00	83.00	.64	22.75	3.80	27.40
199	El Cajon	Dec. 31, 1894	51.00	16.00	84.00	------	10.75	------	11.79
226	Niles	Jan. 3, 1895	56.00	19.00	81.00	------	17.80	------	21.97
235	Biggs	Jan. 4, 1895	42.00	18.00	82.00	------	11.00	------	13.41
285	Merced	Feb. 4, 1895	54.00	18.00	82.00	------	18.45	------	22.50
	Average, 1894–95		42.20	17.50	82.50	.68	16.86	4.00	20.17
	Average, 1891–95		41.50	14.70	81.22	.75	17.60	4.38	21.23
	Uvaria Olive.								
57	Biggs	Dec. 11, 1893	39.00	25.00	75.00	------	11.00	------	14.66
74	Biggs	Dec. 23, 1893	44.00	27.00	73.00	------	9.64	------	13.20
81	Pomona	Dec. 26, 1893	33.00	22.00	78.00	1.05	11.38	4.76	17.40
111	Middletown	Oct. 31, 1894	42.00	28.00	72.00	------	11.45	------	15.90
115	Amador	Nov. 7, 1894	39.00	23.00	77.00	.96	12.50	4.20	16.23
127	Pomona	Nov. 13, 1894	54.00	15.00	85.00	------	10.00	------	11.76
194	Piru City	Dec. 28, 1894	44.00	19.00	81.00	1.20	21.05	6.36	25.98
203	El Cajon	Dec. 31, 1894	75.00	35.00	65.00	------	9.85	------	15.15
207	Danville	Dec. 31, 1894	75.00	40.00	60.00	------	11.00	------	18.66
221	Niles	Jan. 3, 1895	52.00	30.00	70.00	------	15.80	------	22.57
234	Biggs	Jan. 4, 1895	47.00	26.00	74.00	------	13.30	------	17.97
284	Merced	Feb. 4, 1895	54.00	20.00	80.00	------	12.55	------	15.69
	Average, 1894–95		53.60	26.20	73.80	1.08	13.06	5.28	17.76
	Average, 1893–95		45.95	25.43	74.60	1.07	12.22	5.02	16.42
	Atrorubens Olive.								
19	Fresno	Jan. 12, 1892	------	18.50	81.50	.80	21.26	4.20	26.10
49	Biggs	Dec. 11, 1893	28.00	15.00	85.00	.71	16.68	4.11	19.60
147	Fresno	Nov. 19, 1894	22.00	15.00	85.00	------	20.20	------	23.76
243	Biggs	Jan. 5, 1895	36.00	15.00	85.00	------	19.95	------	23.47
	Average, 1894–95		29.00	15.00	85.00	------	20.08	------	23.69
	Average, 1892–95		28.50	15.80	84.10	.75	19.53	------	23.24

TABLE 1.—PARTIAL ANALYSES OF SOME SAMPLES OF CALIFORNIA OLIVES. (CROPS OF 1890–95)—Continued.

Number	Locality.	Date of Picking.	No. of Olives in 100 grams	1 Proportion of Pits and Flesh in Fruits.		2 Percentage of Oil in Whole Fruit Possibly Yielded by		3 Percentage of Oil Contained in Fresh	
				Pits.	Flesh.	Pits.	Flesh.	Pits.	Flesh.
	Nostrale Olive.								
273	Carpinteria	Jan. 22, 1895	57.0	19.00	81.00	------	20.05	------	25.00
	Nigerina Olive.								
50	Biggs	Dec. 11, 1893	36.0	15.00	85.00	.94	18.16	6.24	21.31
85	Pomona	Dec. 26, 1893	23.0	15.00	85.00	.53	22.35	3.46	26.30
149	Fresno	Nov. 19, 1894	20.0	15.00	85.00	------	21.15	------	24.89
224	Niles	Jan. 3, 1895	75.0	34.00	66.00	1.73	12.50	5.10	18.56
	Average, 1894–95		47.5	24.50	75.50	1.73	16.88	5.10	21.70
	Average, 1893–95		38.6	19.80	80.30	1.22	18.57	4.98	22.78
	Atroviolacea Olive.								
5	Fresno	Nov. 4, 1890	------	23.70	76.30	1.19	13.78	5.00	18.10
16	Newcastle	Jan. 14, 1892	------	16.00	84.00	.73	21.90	4.40	26.70
37	Mission San José	Dec. 5, 1893	48.0	25.00	75.00	------	20.83	------	27.80
55	Biggs	Dec. 11, 1893	41.0	20.00	80.00	------	13.74	------	17.17
75	Biggs	Dec. 23, 1893	48.0	25.00	75.00	------	14.69	------	19.58
102	Fresno	Oct. 22, 1894	41.0	25.00	75.00	------	6.85	------	9.13
137	Amador	Nov. 15, 1894	43.0	21.00	79.00	1.32	14.15	6.30	17.99
229	Biggs	Jan. 4, 1895	55.0	21.00	79.00	------	13.00	------	16.45
	Average, 1894–95		46.3	22.30	77.70	1.32	11.34	6.30	17.84
	Average, 1890–95		45.7	22.12	77.90	1.14	14.16	5.50	19.86
	Redding Picholine Olive.								
11	Mission San José	Jan. 8, 1891	------	29.00	71.00	1.88	21.87	6.50	30.80
18	Mission San José	Dec. 16, 1891	------	24.50	75.50	1.17	22.99	4.70	30.70
34	Auburn	Nov. 27, 1893	78.0	21.00	79.00	------	17.08	------	21.60
52	Biggs	Dec. 11, 1893	91.0	25.00	75.00	------	13.27	------	17.70
60	Livermore	Dec. 15, 1893	67.0	23.00	77.00	------	20.80	------	27.00
65	Chico	Dec. 21, 1893	80.0	24.00	76.00	------	15.25	------	20.10
109	Middletown	Oct. 25, 1894	68.0	20.00	80.00	------	13.00	------	16.25
133	Byron	Nov. 14, 1894	93.0	20.00	80.00	------	11.00	------	13.75
136	Amador	Nov. 15, 1894	78.0	22.00	78.00	------	16.20	------	20.78
156	Carpinteria	Nov. 26, 1894	81.0	18.00	82.00	------	11.85	------	14.44
157	Auburn	Dec. 3, 1894	65.0	19.00	81.00	------	17.00	------	20.98
161	Auburn	Dec. 3, 1894	55.0	17.00	83.00	------	15.40	------	18.55
208	Danville	Dec. 31, 1894	112.0	25.00	75.00	------	15.90	------	21.20
227	Fresno	Jan. 3, 1895	83.0	22.00	78.00	------	13.90	------	17.82
266	Hemet	Jan. 16, 1895	95.0	20.00	80.00	------	16.25	------	20.32
269	Carpinteria	Jan. 22, 1895	127.0	32.00	68.00	------	5.45	------	8.01
270	Carpinteria	Jan. 22, 1895	132.0	25.00	75.00	------	14.00	------	18.66
	Average, 1894–95		89.9	21.80	78.20	------	13.33	------	17.11
	Average, 1891–95		84.5	23.10	76.89	------	15.99	------	20.88
	Oblonga Olive.								
20	Fresno	Jan. 12, 1892	------	18.00	82.00	.90	14.95	4.60	18.23
41	Mission San José	Dec. 5, 1893	40.0	25.00	75.00	------	15.10	------	20.10
47	Biggs	Dec. 11, 1893	25.0	15.00	85.00	------	10.85	------	12.80
61	Livermore	Dec. 15, 1893	37.0	21.00	79.00	------	20.50	------	26.00
92	Berkeley	Jan. 4, 1894	67.0	20.00	80.00	------	9.29	------	11.61
76	Biggs	Dec. 23, 1893	34.0	17.00	83.00	------	11.10	------	13.40
98	Fresno	Oct. 15, 1894	40.0	20.00	80.00	------	6.70	------	8.38
107	Fresno	Oct. 22, 1894	33.0	19.00	81.00	------	5.40	------	6.66
108	Fresno	Oct. 22, 1894	37.0	20.00	80.00	------	7.30	------	9.12
121	Piru City	Nov. 12, 1894	27.0	20.00	80.00	1.10	11.25	5.50	14.06
141	Whittier	Nov. 17, 1894	35.0	18.00	82.00	------	15.25	------	18.59
217	Niles	Jan. 3, 1895	40.0	18.00	82.00	.55	9.00	3.10	10.97
233	Biggs	Jan. 4, 1895	29.0	17.00	83.00	------	14.15	------	17.04
274	Carpinteria	Jan. 22, 1895	58.0	21.00	79.00	------	11.05	------	13.95
	Average, 1894–95		37.4	19.10	81.10	.83	10.00	4.30	12.33
	Average, 1892–95		39.0	19.05	80.88	.865	11.82	4.45	14.68

TABLE 1.—Partial Analyses of some Samples of California Olives. (Crops of 1890-95)—Continued.

Number	Locality.	Date of Picking.	No. of Olives in 100 grams	1 Proportion of Pits and Flesh in Fruits.		2 Percentage of Oil in Whole Fruit Possibly Yielded by		3 Percentage of Oil Contained in Fresh	
				Pits.	Flesh.	Pits.	Flesh.	Pits.	Flesh.
	Columbella Olive.								
22	Fresno	Jan. 12, 1892	------	17.00	83.00	.50	15.20	3.10	18.35
45	Mission San José	Dec. 15, 1893	49.00	25.00	75.00	------	16.32	------	21.80
56	Biggs	Dec. 11, 1893	28.00	15.00	85.00	.63	13.53	4.20	16.00
80	Pomona	Dec. 26, 1893	19.00	15.00	85.00	.68	17.39	4.62	20.05
91	Berkeley	Jan. 4, 1894	70.00	20.00	80.00	------	14.13	------	17.65
219	Niles	Jan. 3, 1895	26.00	20.00	80.00	------	16.25	------	20.32
237	Biggs	Jan. 4, 1895	20.00	14.00	86.00	------	11.95	------	13.89
	Average, 1894-95	------	23.00	17.00	83.00	------	14.10	------	17.06
	Average, 1892-95	------	32.25	17.70	82.30	------	14.70	------	17.92
	Præcox Olive.								
21	Fresno	Jan. 12, 1892	------	17.00	83.00	.60	12.87	3.09	15.40
54	Biggs	Dec. 11, 1893	48.0	19.00	81.00	1.10	16.86	6.06	20.00
93	Berkeley	Jan. 4, 1894	71.0	20.00	80.00	.72	10.67	3.60	13.35
99	Fresno	Oct. 15, 1894	42.0	25.00	75.00	------	7.10	------	9.47
143	Tulare	Nov. 17, 1894	43.0	20.00	80.00	.98	18.40	4.96	23.00
205	El Cajon	Dec. 31, 1894	29.0	15.00	85.00	------	9.25	------	10.88
239	Biggs	Jan. 4, 1895	50.0	18.00	82.00	.81	14.00	4.55	17.07
	Average, 1894-95	------	41.0	19.50	80.20	.90	12.19	4.76	15.09
	Average, 1892-95	------	50.3	18.80	80.60	.85	12.84	4.63	15.80
	Pendulina Olive.								
3	Fresno	Nov. 4, 1890	------	14.80	85.20	1.04	17.40	7.00	20.50
84	Pomona	Dec. 26, 1893	29.0	13.90	87.00	.92	18.81	7.10	21.70
103	Fresno	Oct. 22, 1894	32.0	12.00	88.00	------	11.00	------	12.50
142	Tulare	Nov. 17, 1894	31.0	14.00	86.00	------	19.75	------	22.99
220	Niles	Jan. 3, 1895	48.0	16.00	84.00	------	16.40	------	19.52
242	Biggs	Jan. 4, 1895	33.0	13.00	87.00	------	15.25	------	17.53
280	Piru City	Jan. 31, 1895	38.0	12.00	88.00	.93	24.00	7.77	27.38
286	Merced	Feb. 4, 1895	43.0	13.00	87.00	------	10.25	------	11.78
	Average, 1894-95	------	37.5	13.40	85.00	.93	16.11	7.77	18.60
	Average, 1890-95	------	33.3	13.65	85.60	.96	17.11	7.41	19.85
	Becca Rufa Olive.								
51	Biggs	Dec. 11, 1893	58.0	19.00	81.00	1.10	21.05	6.00	25.29
241	Biggs	Jan. 4, 1895	50.0	18.00	82.00	------	16.50	------	20.12
	Average	------	54.0	18.50	81.50	------	18.78	------	22.70
	Razzo Olive.								
67	El Quito	Dec. 22, 1893	52.0	20.00	80.00	1.08	23.59	3.65	33.70
134	Amador	Nov. 14, 1894	48.0	26.00	74.00	.61	16.95	2.42	22.90
255	Pomona	Jan. 14, 1895	40.0	23.00	77.00	.83	23.95	3.60	31.10
257	El Quito	Jan. 14, 1895	46.0	30.00	70.00	------	21.90	------	31.28
	Average	------	51.6	23.80	76.20	.84	19.43	3.22	26.48
	Correggiolo Olive.								
68	El Quito	Dec. 22, 1893	53.0	33.00	70.00	1.20	20.29	4.07	28.98
184	Santa Barbara	Dec. 24, 1894	50.0	22.00	78.00	------	23.75	------	30.45
251	Berkeley	Jan. 11, 1895	59.0	22.00	78.00	------	18.00	------	23.08
252	Berkeley	Jan. 11, 1895	64.0	24.00	76.00	------	17.60	------	23.15
260	El Quito	Jan. 14, 1895	84.0	32.00	68.00	1.28	13.00	3.70	19.10
	Average	------	62.0	26.60	74.00	1.24	18.53	3.89	25.17
	Morajolo Olive.								
69	El Quito	Dec. 22, 1893	55.0	33.00	67.00	1.45	21.93	4.43	32.72
261	------	Jan. 14, 1895	101.0	31.00	69.00	------	17.00	------	24.63
	Average	------	78.0	32.00	68.00	------	19.46	------	28.60

TABLE 1.—PARTIAL ANALYSES OF SOME SAMPLES OF CALIFORNIA OLIVES. (CROPS OF 1890-95)—Continued.

Number	Locality.	Date of Picking.	No. of Olives in 100 grams	1 Proportion of Pits and Flesh in Fruits.		2 Percentage of Oil in Whole Fruit Possibly Yielded by		3 Percentage of Oil Contained in Fresh	
				Pits.	Flesh.	Pits.	Flesh.	Pits.	Flesh.
	Regalis Olive.								
44	Mission San José	Dec. 5, 1893	34.0	22.00	78.00	1.19	16.85	5.47	21.60
130	Pomona	Nov. 13, 1894	15.0	12.00	88.00	.84	14.00	7.05	15.99
163	Tulare	Dec. 3, 1894	31.0	16.00	84.00	.84	16.80	5.20	20.00
222	Niles	Jan. 3, 1895	31.0	20.00	80.00	------	15.00	------	18.75
230	Biggs	Jan. 4, 1895	24.0	13.00	87.00	------	12.25	-----	14.08
	Average		27.0	16.60	83.40	.95	14.98	5.54	18.09
	Grossajo Olive.								
70	El Quito	Dec. 22, 1893	53.0	28.00	72.00	1.03	25.03	3.72	34.76
258	El Quito	Jan. 14, 1895	89.0	32.00	68.00	------	18.75	------	27.57
123	Piru City	Nov. 12, 1894	49.0	23.00	77.00	------	21.20	------	27.52
	Average		64.0	27.70	72.30	------	21.66	------	29.57
	Frantojo Olive.								
66	El Quito	Dec. 22, 1893	74.0	30.00	70.00	1.00	18.69	3.36	26.70
185	Santa Barbara	Dec. 24, 1894	69.0	23.00	77.00	------	29.05	------	37.71
262	El Quito	Jan. 14, 1895	124.0	32.00	68.00	------	14.55	------	21.39
	Average		89.0	28.30	71.70	------	21.30	------	28.60
	Columbaro Olive.								
59	Biggs	Dec. 14, 1893	23.0	15.00	85.00	.50	17.73	3.38	20.85
	Polymorpha Olive.								
78	Biggs	Dec. 23, 1893	13.0	17.00	83.00	.66	13.65	3.90	16.40
97	Fresno	Oct. 15, 1894	15.0	20.00	80.00	.65	10.25	3.25	12.81
236	Biggs	Jan. 4, 1895	15.0	15.00	85.00	------	11.50	------	13.53
281	Piru City	Jan. 31, 1895	18.0	18.00	82.00	1.33	20.90	6.50	25.48
	Average		15.2	17.50	82.50	.88	14.07	4.55	17.05
	Hervaza Olive.								
90	Berkeley	Jan. 4, 1894	21.0	17.00	83.00	.37	12.98	2.20	15.60
244	Berkeley	Jan. 11, 1895	28.0	13.00	87.00	------	14.75	------	16.95
	Average		24.5	15.00	85.00	------	13.87	------	16.75
	Lucques Olive.								
88	Livermore	Dec. 28, 1893	67.0	30.00	70.00	1.00	13.06	3.32	18.70
104	Fresno	Oct. 22, 1894	23.0	17.00	83.00	------	11.25	------	13.55
171		Dec. 8, 1894	55.0	28.00	72.00	-----	10.25	------	14.38
204	El Cajon	Dec. 31, 1894	27.0	15.00	85.00	1.17	12.00	7.80	14.11
	Average		43.0	22.50	77.50	1.09	11.64	5.56	15.18
	Piangente Olive.								
89	Berkeley	Jan. 4, 1894	76.0	22.00	78.00	.86	13.48	3.92	17.30
249	Berkeley	Jan. 11, 1895	103.0	25.00	75.00	------	9.95	------	13.27
	Average		89.5	23.50	76.50	------	11.72	------	15.29
	Amellau Olive.								
48	Biggs	Dec. 11, 1893	19.0	16.00	84.00	.48	14.00	3.02	17.50
213	Niles	Jan. 3, 1895	28.0	22.00	78.00	.71	16.75	3.20	21.47
238	Biggs	Jan. 4, 1895	18.0	15.00	85.00	------	16.80	------	19.76
	Average		21.7	17.70	82.30	.60	16.52	3.11	16.22
	Macrocarpa Olive.								
101	Fresno	Oct. 22, 1894	15.0	17.00	83.00	.68	8.95	3.97	10.73
120	Piru City	Nov. 12, 1894	17.0	17.00	83.00	.90	19.40	5.30	23.31
209	Niles	Jan. 3, 1895	15.0	18.00	82.00	.66	11.00	3.76	13.47
211	Niles	Jan. 3, 1895	18.0	18.00	82.00	.74	15.55	4.10	18.98
228	Biggs	Jan. 4, 1895	18.0	17.00	83.00	.56	10.10	3.33	12.17
	Average		16.6	17.40	82.60	.70	13.00	4,18	15 76

TABLE 1.—Partial Analyses of some Samples of California Olives. (Crops of 1890–95)—Continued.

Number	Locality.	Date of Picking.	No. of Olives in 100 grams	1 Proportion of Pits and Flesh in Fruits.		2 Percentage of Oil in Whole Fruit Possibly Yielded by		3 Percentage of Oil Contained in Fresh	
				Pits.	Flesh.	Pits.	Flesh.	Pits.	Flesh.
	Salonica Olive.								
240	Biggs	Jan. 4, 1895	28.0	13.00	87.00	.44	13.85	3.42	15.90
215	Niles	Jan. 3, 1895	33.0	20.00	80.00	.56	16.60	2.80	20.75
279	Piru City	Jan. 31, 1895	29.0	14.00	86.00	.70	23.70	5.00	27.55
154	Amador Station	Nov. 22, 1894	31.0	12.00	88.00	.50	21.25	4.18	24.14
	Average		30.2	14.70	85.25	.55	18.85	3.85	22.08
	Morinello Olive.								
246			91.0	30.00	70.00	.86	15.00	2.88	21.43
168	Santa Barbara	Dec. 6, 1894	86.0	28.00	72.00	1.15	21.70	4.14	30.13
254	Pomona	Jan. 14, 1895	41.0	16.00	84.00	1.00	24.75	6.24	29.46
	Average		72.6	24.60	75.33	1.00	20.48	4.42	27.00
	Sevillano Olive.								
151	Pomona	Nov. 19, 1894	6.0	16.00	84.00	.40	19.20	2.47	22.85
214*	Niles	Jan. 3, 1895	21.0	20.00	80.00	.84	15.65	4.20	19.56
	Average		14.0	18.00	82.00	.62	17.42	3.33	21.20
	Pleureur de Grasse Olive.								
126*	Piru City	Nov. 12, 1894	12.0	15.00	85.00	.66	15.00	4.44	17.65
268	Carpinteria	Jan. 22, 1895	47.0	21.00	79.00	.88	24.35	4.20	30.82
272	Carpinteria	Jan. 22, 1895	40.0	20.00	80.00	.69	22.25	3.45	27.81
110	Piru City	Oct. 29, 1894	12.0	13.00	87.00	.73	18.00	5.63	20.69
	Average		27.7	17.20	82.70	.74	20.00	4.43	24.24
	Verdale Olive.								
212	Niles	Jan. 3, 1895	34.0	20.00	80.00	.84	14.00	4.20	17.50
172		Dec. 8, 1894	17.0	15.00	85.00	.46	14.75	3.06	17.38
	Average		25.5	17.50	82.50	.65	14.36	3.63	17.44
	Cucco Olive.								
259	El Quito	Jan. 14, 1895	20.0	16.00	84.00	.58	16.75	3.63	20.00
186	Santa Barbara	Dec. 24, 1894	79.0	21.00	79.00	.82	25.25	3.90	31.95
	Average		49.5	18.50	81.50	.70	21.00	3.76	25.97
	Picholine Olive.								
128	Pomona	Nov. 13, 1894	15.0	20.00	80.00	.72	15.25	3.60	19.06
	Picholine de St. Chamas Olive.								
218	Niles	Jan. 3, 1895	14.0	20.00	80.00	.62	13.20	3.10	16.50
	Average Picholine		14.5	20.00	80.00	.67	14.22	3.35	17.78
	Ascolano Olive.								
131	Pomona	Nov. 13, 1894	13.0	12.00	88.00	.60	13.15	5.01	14.94
	Ascoli (?) Olive.								
250	Berkeley	Nov. 13, 1894	21.0	16.00	84.00	.54	13.80	3.41	16.42
	Empeltre (?) Olive.								
150	Fresno	Nov. 19, 1894	23.0	15.00	85.00	.70	18.10	4.66	21.47
106	Fresno	Oct. 22, 1894	24.0	15.00	85.00	.80	20.00	5.30	23.52
	Obliza Olive.								
96	Fresno	Oct 15, 1894	17.0	11.00	89.00	.37	9.45	3.39	10.61
	Solanequo (?) Olive.								
216	Niles	Jan. 3, 1895	32.0	18.00	82.00	.45	19.00	2.50	23.17

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* We are not certain that this sample is true to name.

TABLE 1.—PARTIAL ANALYSES OF SOME SAMPLES OF CALIFORNIA OLIVES. (CROPS OF 1890-95)—Continued.

Number	Locality.	Date of Picking.	No. of Olives in 100 grams	1 Proportion of Pits and Flesh in Fruits.		2 Percentage of Oil in Whole Fruit Possibly Yielded by		3 Percentage of Oil Contained in Fresh	
				Pits.	Flesh.	Pits.	Flesh.	Pits.	Flesh.
	Santa Caterina Olive.								
129	Pomona	Nov. 13, 1894	18.0	16.0	84.0	.52	12.75	3.25	15.17
	Huff's Spanish (?) Olive.								
210	Niles	Jan. 3, 1895	62.0	22.0	78.0	.99	17.25	4.60	22.11
	Dalmatian Olive.								
245	Berkeley	Jan. 11, 1895	24.0	18.0	82.0	.63	16.85	3.50	20.54
	Olea Maria Olive.								
174	Santa Barbara	Dec. 13, 1894	37.0	16.0	84.0	.77	14.15	4.80	16.84
	Lavagnino Olive.								
288	Berkeley	Feb. 13, 1895	67.0	20.0	80.0	------	22.75	------	28.43
	Morchiaio Olive.								
187	Santa Barbara	Dec. 24, 1894	65.0	24.0	76.0	.36	27.45	2.60	36.11
	Palazzriolo Olive.								
188	Santa Barbara	Dec. 24, 1894	74.0	20.0	80.0	.67	31.10	3.37	38.87
	Infrantojo Olive.								
247	Berkeley	Dec. 24, 1894	89.0	20.0	80.0	.90	10.00	4.50	12.50
	Leccino Olive.								
248	Berkeley	Dec. 24, 1894	72.0	22.0	78.0	.95	17.25	4.30	22.11

Number	Designation	Locality.	Date of Picking.	No. of Olives in 100 grams	Proportion of Pits and Flesh in Fruits.		Oil in Whole Fruit.		Oil in Fresh	
					Pits.	Flesh.	Pits.	Flesh.	Pits.	Flesh.
		Olives of Unknown	**Varieties.**							
113	?	Tulare	Nov. 3, 1894	30.0	13.0	87.0	------	12.00	------	13.71
125	No. 3	Piru City	Nov. 12, 1894	16.0	16.0	84.0	------	20.40	------	24.28
144	?	Tulare	Nov. 17, 1894	27.0	13.0	87.0	------	11.85	------	13.62
146	?	Tulare	Nov. 19, 1894	22.0	17.0	83.0	------	20.85	------	24.70
167	?	Concord	Dec. 3, 1894	38.0	17.0	83.0	------	15.15	------	18.25
196	7	Piru City	Dec. 28, 1894	18.0	15.0	85.0	------	18.65	------	21.92
197	8	Piru City	Dec. 28, 1894	20.0	16.0	84.0	------	22.75	------	27.08
198	6	Piru City	Dec. 28, 1894	10.0	10.0	90.0	------	19.00	------	21.11
264	?	Berkeley	Jan. 14, 1894	79.0	23.0	77.0	------	11.10	------	14.41

TABLE 2.—AVERAGES BY OLIVE VARIETIES, WITH MAXIMUM AND MINIMUM.

Variety.	Number of Samples Examined	Percentage of Oil in Fresh Flesh.					Number of Olives in 100 Grams.				Percentage of Flesh in Whole Fruit.			Percentage of Pit in Whole Fruit.		
		Maximum	Minimum	Average.		Variation (5 Years)	Maximum	Minimum	Average.		Maximum	Minimum	Average	Maximum	Minimum	Average
				1890–95.	1894–95.				1890–95.	1894–95.						
Mission	45	32.31	17.23	22.19	21.45	15.08	47	13	27.53	24.80	87	74	81.70	26	13	18.15
Manzanillo	17	26.40	13.90	20.96	19.35	12.50	55	16	23.70	26.30	90	83	84.90	22	13	15.20
Nevadillo Blanco	25	32.06	13.71	22.94	21.04	18.35	70	25	36.00	37.00	87	75	81.50	25	13	18.80
Rubra	18	34.00	11.47	21.23	20.17	22.53	56	23	41.50	42.20	85	80	81.22	21	15	14.70
Redding Picholine	17	30.80	8.01	20.88	17.11	22.70	132	55	84.50	89.90	83	68	76.89	32	17	23.10
Oblonga	14	26.00	6.66	14.68	12.33	19.34	67	25	39.00	37.40	85	79	80.88	25	15	19.05
Uvaria	12	25.00	11.70	16.42	17.76	12.30	75	33	45.95	53.60	85	60	84.60	40	15	25.43
Pendulina	9	27.38	11.70	19.85	18.60	15.57	48	29	33.30	37.50	89	84	85.60	16	12	13.65
Præcox	7	23.00	13.35	15.80	15.09	9.65	71	29	50.30	41.00	85	75	80.60	25	15	18.80
Columbella	7	21.80	13.80	17.92	17.06	8.00	70	19	32.25	23.00	86	75	82.30	25	14	17.70
Lucques	4	18.70	13.55	15.18	13.97	5.15	67	23	43.00	35.00	85	70	77.50	30	15	22.50
Polymorpha	4	25.50	12.81	17.05	17.27	12.69	18	13	15.20	16.00	85	80	82.50	20	15	17.50
Atroviolacea	8	27.80	9.13	19.86	17.84	18.67	55	41	45.70	46.30	84	75	77.90	25	16	22.12
Razzo	4	33.70	22.90	26.48	--------	--------	52	40	51.60	--------	80	70	76.20	30	20	23.80
Correggiolo	5	30.45	19.10	25.17	--------	--------	84	50	62.00	--------	78	68	74.00	33	22	26.60
Regalis	5	21.60	14.08	18.09	--------	--------	34	15	27.00	--------	87	78	83.40	22	12	16.60
Nigerina	4	26.30	18.50	22.78	21.70	--------	75	20	38.60	47.50	85	66	80.30	34	15	19.80
Atrorubens	4	26.10	19.60	23.24	23.69	6.50	36	22	28.50	29.00	85	81	84.10	18	15	15.80
Macrocarpa	5	23.37	10.78	15.73	--------	--------	18	15	16.60	--------	83	82	82.60	18	17	17.40
Salonica	4	27.50	15.90	22.08	--------	--------	33	28	32.00	--------	88	80	85.25	20	12	14.70
Morinello	3	30.13	21.43	27.00	--------	--------	91	41	72.60	--------	84	70	75.33	30	16	24.60
Sevillano	2	22.85	19.56	21.20	--------	--------	21	6	14.00	--------	84	80	82.00	20	16	18.00

The thanks of the department are due to all the public-spirited olive-growers who sent samples for analyses, as well as valuable data concerning new varieties and new regions.

Special thanks are due to Mr. John Rock, of Niles, who generously donated large lots of olives, enabling the Station to practically demonstrate to the class in olive culture the actual process of oil-making and pickling. Professor Hilgard also donated several hundred pounds of olives for the same purposes from his private orchard at Mission San José.

II.

REPORTS ON ENTOMOLOGY AND PLANT DISEASES.

Notes from the Correspondence of the Office, on Various Diseases and Insects.
Laboratory Notes.
The Black Scale.
The Lecaniums of California.

ENTOMOLOGY AND PLANT DISEASES.

NOTES FROM CORRESPONDENCE.

By C. W. Woodworth.

CROWN KNOT.

There seems to be very much less trouble with this disease at this time than two or three years ago. Nothing is known as to the cause, beyond the fact that the parasite theory seems best to agree with what we know of the disease; and the more we know the more fully this theory seems justified. The method of treatment first recommended by us upon that hypothesis has proven eminently satisfactory, and all the methods that have produced results have been in further support of the idea. The only extensive experiments made—those of Mr. B. M. Lelong, of the State Board of Horticulture—do not seem to support this idea, though perhaps they only signify that, under the conditions of his experiments, the disease was not infectious; and that, under *other* conditions, experiments might entirely verify what observation seems to indicate. The University has been unable to institute these experiments, because we could find no nursery stock in sufficient quantity and in the right condition to give value to the work.

County Commissioners uniformly condemn knotted trees, depending upon a legal opinion rendered some time ago on the basis of Bulletin No. 99 of this Station. Now, if Mr. Lelong's experiments are really exhaustive and his conclusions justified, there is grave doubt of the legal right of condemning knotty trees, especially where the knots are so situated as to be wholly removable. On the other hand, if the surmises of this department are right, the county inspectors are not generally doing their work with this disease thoroughly enough.

Not being able to present the results of exhaustive experiments, we will simply present the evidence now in hand which seems to favor the idea of the communicability of the disease.

(1) *The disease is distinct.* Under every condition of soil, climate, and host-plant, the disease has the same characteristics, and to be always and immediately distinguishable from other forms of hypertrophied plant tissue. This fact is to be explained upon no theory other than that it is caused by the attacks of a particular organism. It is not intended to claim that all crown knots are alike, nor that the host-plant, climate, or soil do not have a recognizable effect on the gall; but rather, that in all essential particulars the knots are the same, just as a potato is recognizable as a potato, no matter what its shape or size or condition.

(2) *The disease is successfully treated with fungicides.* If a knot is removed from a tree, it will commonly return; but upon the use of any of the standard fungicides it appears that the return is quite prevented. The growth of knots is stopped by injecting into them a sufficient

quantity of a fungicide, and indeed, as already remarked, all the known successful methods are based upon the supposition of the parasitic origin of the disease.

(3) *The appearance of the disease is erratic.* It does not seem to be connected in any tangible way to any observable external conditions; it may be entirely absent for a considerable time, or over a considerable area, and may suddenly appear and then as suddenly disappear. Of the theories that have been proposed, only the parasite theory seems to account for manifestations sufficiently erratic to suit the facts observed.

(4) *The disease often follows wounds.* One of the earliest observations and explanations of the disease was plow-wounds, and it is certain that it often follows such injuries. It is equally certain that there is scarcely any similarity between the normal healing of a wound and the crown knot. The presence of knots where the roots were cut when the tree was removed from the nursery is a very common observation, but, most commonly, the roots heal normally. Again, when part of the roots are uncovered to examine a knot at the crown, it is not uncommon, at a subsequent examination, to find the disease to have spread to all the parts so exposed. These observations all point to the inoculation of the healthy parts of the tree with the germ of the disease, and it is in no way opposed to this theory to find that these results are rather the exception than the rule—that is, that in the majority of cases infection does not follow.

(5) *The disease is conveyed by insects.* This fact was brought out in our last report, where it was shown beyond question that the woolly aphis had spread the disease over the roots of some seedling apples.

TRUNK KERNEL.

A disease quite confined to the trunk and larger branches, and which has often been supposed to be the crown knot, or akin to it, may be known as the *trunk kernel.* It does not seem to injure the tree beyond making a rough bark, and it would hardly be called a disease from an agricultural standpoint; so, chiefly to distinguish it from other and injurious diseases, will it be mentioned.

Within the soft, growing tissue just under the bark, small, hard, woody kernels are found when this disease is present. The appearance is well described by Mr. E. O. Gerberding, of Hueneme, Ventura County (October 7, 1891), who sent "some samples of a curious growth found on magnolia trees. * * * This is the first year the growth has appeared, but some of the trees are covered with it. In appearance it may be said to resemble warts, while the kernel inside is very hard."

The cells of the layer of the tree in which these growths occur are capable, under some circumstances, of developing into buds; and it would seem that these kernels are cells that started to make buds, but for some reason failed in this. They keep on growing, however, and push the bark out into the wart-like structures described above. Finally, they become united with the hard wood of the tree, and are surrounded as the trunk grows, making a knot-like structure in the wood.

The cause is very obscure, but quite possibly it is due to bruises made at the right time. Some trees are very much more susceptible than others; the pear, at least certain varieties, is very much affected.

The injury seems to be confined to the roughening of the bark.

TWIG KNOT.

On certain varieties of quince there is a very conspicuous structure, which is entirely normal, a mere idiosyncrasy of the variety, but which has often been supposed to be related to the crown knot.

On all trees the bark forms something of a fold around the buds, which becomes more and more evident as the bud develops into a twig, and often breaks and becomes rough. In the quince this fold is very evident, especially in certain varieties, where it becomes quite a knot.

Mr. A. J. Waddell, of Gualala, Mendocino County (June 22, 1895), writing in reference to this knot, says: "About three years ago I first noticed it on one tree; now it is on several." This is an experience that many have had, for the young trees do not show the peculiarity as conspicuously as they do later.

POWDERY BARK.

While quite common in California, powdery bark has never, I believe, been recognized as a distinct disease, generally being confounded with insect work. The outer bark of the affected spots dries up, cracks, and often curls back, exposing a layer of brown tissue, which readily breaks up into fine powder. Beneath this powdery layer the bark is either normal or dead; and, in the latter case, the branch usually dies also. The powdery layer is similar in general appearance to that left in the cavities made by various borers, and has thus been usually mistaken for insect work. The true explanation of the trouble is as follows: The disease usually starts as a blister, and commonly is produced in the spring upon exposed wood of the previous season's growth. If the injury does not entirely kill the growing layer of the bark, and the conditions are right for growth, a considerable layer of tissue is produced, quite different from normal cork, and the wound is healed over. This temporary, rapidly growing cork dries up finally, as does all cork tissue; never attaining, however, the toughness of normal cork, but, instead, becomes a layer of very friable cells.

Every one is somewhat acquainted with this kind of tissue, because of its abundance in the bark of the cork oak. All second-quality cork may be seen to have it in many of the holes, and it represents so many attempts at healing the injuries to which the holes are due. Sometimes, after the tree has healed to the extent of producing this layer of powdery cork, the bark will be killed entirely into the wood, and then the stem usually dries up and dies. Commonly, the production of the powdery layer is sufficient protection and the ordinary normal bark is produced. Powdery bark is, then, the most striking characteristic of a disease, but is itself more like a scar, which simply indicates what and where the disease had been.

GUM DISEASE.

Gum Disease of Citrus Trees.—One of the most serious troubles connected with citrus-growing, in many localities, is the gum disease. It is a parasitic disease, although apparently not due to any particular parasite, but usually to a combination of several. Any disease of the orange or lemon which produces the exudation of gum would be called gum disease, and sometimes it may be that the cause is different from what is here described; but the common Californian trouble is what is meant.

Two forms of the disease may be distinguished—one originating at or near the crown, and the other attacking the deeper parts of the roots. The latter form is also called root-rot or foot-rot, and is practically uncontrollable, while the former is very easily cured. The disease may originate at the crown and kill the tree, and so infect the soil that replantings succumb through attack of the root form. Thus, Mr. Abbot Kinney, of Lamanda Park, Los Angeles County (November 21, 1892), in sending specimens of diseased roots, says: "Every root cut before planting became diseased. The young tree was dying, much of the upper growth being dead, and the few remaining leaves yellow. The tree stood where an old tree had died of foot-rot some years ago. Two other young trees have died in the same place with the same trouble."

The most common cause of the disease has been the destruction of some of the bark near the surface of the ground, and the covering of the dead tissue with moist earth.

Mr. W. W. Whitney, of San Diego (October 14, 1891), sent us a "piece of bark from an orange tree growing on a hillside, and somewhat buried with the earth which had been washed down by the rains. Water had been applied in basin form." It appeared that the bark had first been injured by the water; and then, being kept moist, offered an inducement to the disease organisms.

Another case, which is very striking, has also been brought to our attention. An orchard planted to alfalfa, and the latter plowed-in green, became badly affected, and examination showed that almost invariably where the decaying alfalfa had been in contact with the tree the disease had started.

A careful résumé of our observations shows that the disease originates only under the following conditions:

(1) *Moisture.* The disease always originates in the moist condition found beneath the surface of the ground.

(2) *Dead and decaying organic substance.* This may be furnished by the decay of the tree itself when the bark is killed by either basin irrigation or otherwise; or by the decay of other plants, as in the case of the alfalfa cited above; or by replanting in places containing the decaying roots of trees that had died of the disease.

The disease is only capable of entering healthy tissue after getting a start in decaying tissue. The organisms are simply some of the decay-producing forms, which develop a poison fatal to the tissue of the citrus trees; and, as the tissue dies, the disease spreads, until it involves enough of the tree to cause its death.

The remedy is to remove the diseased tissue, keep the place exposed to the air, and the tree will heal itself.

If the disease be allowed to go too far, it may be necessary to wrap the wounds after exposing for a day or so, or the tree will dry up, too. The disease has been cured after the tree was completely girdled. When the disease involves the roots to any extent, it is impracticable to treat them in this way, and there is not much hope for the tree; nor can any trees be planted with safety where the old tree has been removed.

Gum Disease of Stone Fruits.—Gumming in stone fruits may occur from almost any cause, and often with great profusion. What is most commonly called the "gum disease" is the attack of fungi belonging to the *Hymenomycetes*, the common "toadstool" fungi. Quite a large number of species may produce it, but usually there is but one kind on a tree.

The common appearance is well described by Mr. R. S. Patten, of Arroyo Grande, (February 9, 1893), who writes in reference to the disease on apricot: "The lower roots seem to die first, and a mildew is found between bark and wood, sometimes extending a few inches up the trunk. * * * Some of the worst affected orchards are on deep soil, where live oak timber has been cleared away."

The tree gums very freely where attacked by the disease, and usually dies before the disease reaches up into the branches. Sometimes the toadstool will fruit before the tree is dead, but generally not.

The disease seems to be uncontrollable; it is most prevalent in oak clearings, and generally a replanted tree will take the disease.

We have recommended the removal of a large amount of earth, the lining of the hole with iron or copper sulphate, and then filling it with new earth, and planting; apparently good results were obtained.

ROOT-ROT.

This term is applied to all forms of root disease. It is very commonly applied to the toadstool disease of non-gumming trees. The only difference between this and that mentioned above is the absence of the gum, and the less degree of susceptibility.

SOUR-SAP.

This is a disease due to a number of forms of bacteria. Like the gum disease of the orange, the organisms are not properly parasites, but rather decay-producing forms, which, under peculiar circumstances, have become parasitic. Two forms of sour-sap may be distinguished—the root, and the top souring. The former commonly follows standing water, and is particularly common in a hollow lined with hardpan. The latter is most abundant in the spring, and follows late severe frosts.

Mr. P. H. Atkinson, of Sebastopol, Sonoma County (April 15, 1894), writes in reference to the disease in his prune orchard: "The trees recently budded out, some of them bloomed, and about 20 to 25 per cent began to wilt and die; * * * you will notice that there is quite a sour smell. I have had one or two cases in former years, but nothing like the wholesale destruction now going on. People here call it sour-sap, but do not know what is the cause of it, nor what remedy to adopt. If the tree is cut back (nearly all the top being taken off) it sometimes revives, but generally dies altogether; at other times the top dies and the Myrobalan root sends up suckers. The trees affected are in all kinds of positions. * * * I have had the same thing happen occasionally to peaches, but not to any extent."

When the disease is noticed, the tree is generally beyond help, though it sometimes revives. The treatment, if on the roots, is drainage of the soil; if above ground, severe pruning.

BLIGHT; DIE-BACK.

Under these names are grouped a number of diseases of doubtful character, supposedly bacterial. I will quote three letters in reference to them.

Mr. Ernst Leuhning, of Newcastle, Placer County (April 9, 1895), writes in reference to the disease on plums and apricots: "About half the trees are dead or dying; the leaves come out, are slightly yellow looking, and then drop off. Trees next to the dead ones are healthy and growing strong. * * * The bark on the affected ones show brown and black spots; when one makes a cut with a knife, sometimes half around the trunk all is black, sometimes all of it. On some, only certain limbs seem to be affected; the rest of the tree grows all right. Often the top dies back, and from the roots comes a vigorous shoot."

Mr. John P. Dunlap, of Diamond Springs, El Dorado County (May 17, 1894), writes: "A few of the trees in my Bartlett pear orchard have been sickly for the last two or three years. * * * The symptoms are as follows: Soon after leafing out, the leaves begin to die back, till in some cases (this year) the tree is quite denuded of leaves. When the heat of the summer comes the tree puts out new leaves, which look quite healthy, but the growth of the wood is greatly stunted. The sickness begins from the tips of the twigs. * * * I have always cut off the diseased parts of the trees till this year."

S. Hargrave, of Banning, Riverside County (May 15, 1893), sent infested "twigs of the French prune. On some trees, for several years, an occasional limb has shown disease, while the remainder of the tree seems all right, bearing crops; but these limbs so decline in vigor as to fail to bear, and finally die. This spring many trees are affected all over, and look sad enough. Many blossomed feebly and dropped their fruit. The leaves get started and are seldom half grown, when they turn pale, growth stops, and the edges of the leaves turn red and curl."

The specimens sent with these letters, and many more like them, show the wood to be diseased in a way to remind one of pear blight, and I have but little doubt that careful bacteriological study would show them to be similar in character.

The only thing that can be suggested, by way of remedy, is vigorous pruning and the use of fungicides, with the probability, however, that neither will prove wholly satisfactory.

ALKALI.

A number of symptoms, which are by many looked upon as the effect of drought or of the attack of fungi, are really referable to the effect of alkali in the soils. In alkali regions it is also quite common to refer everything to alkali. It becomes, therefore, very desirable to be able to ascertain the real nature of the troubles from this source. I have thus far been able to recognize four distinct effects produced by alkali: The girdling near the surface of the ground; the destruction of the root hairs; the concentration of the alkali in the green parts; and the burning due to soil radiation.

The first is the most evident, and is scarcely ever confounded with anything else. It occurs chiefly in very strongly alkali soils. The tree is simply burned by the crust of alkali that accumulates at the surface of the ground because of evaporation from the soil. The tree dries up and dies, and an examination of the blackened and generally eroded band about the collar will leave no doubt as to the point of injury. The only question that will arise will be in regard to cases where there is a complication of troubles, where neither one alone will seem to be far enough developed to explain the death of the plant.

The preventive measures that will suggest themselves are the cultivation of the ground, especially of that close to the trees, to prevent, to some extent, the accumulation of alkali here. The use of plaster around the tree to neutralize the worst alkali, and the periodical replacing of the soil, where practical, by that known to be comparatively free from alkali. (See article on alkali soils in this report, p. 37.)

The second method of injury—that to the root hairs—is the commonest, and, to the farmers, the least understood trouble. The symptoms are exactly those of drought, while the soil may have an abundance of water. When acute, the leaves lose their tense normal appearance and gradually dry out, beginning at the tips or edges, the growth of the tree ceases, the youngest leaves quite dry up, and the appearance of the tree, as a whole, is very bad. When not acute the leaves become yellowed early in the season, and drop off, leaving the tree almost bare long before the normal time. Generally the symptoms are intermediate between these two conditions.

An examination of the roots without the use of a good microscope generally reveals nothing but healthy tissue; and while the appearance of the leaves is well known as alkali injury, only a few comprehend that the injury is primarily to the roots.

The plant obtains its water supply chiefly through innumerable, extremely small, hair-like projections from the youngest and finest rootlets. These organs are very delicate, and are destroyed by a degree of dryness or of drought much less than would be necessary to injure the older roots. Professor Hilgard has shown, in previous reports, how the alkali of a soil rises and falls during the season, and we see at once the bearing of this fact on the health of the tree.

A peculiarity often noticed in regard to this character of injury is its appearance in spots in an orchard. Often a few trees will die, those immediately around them will be badly injured, and beyond these some less injured. This corresponds entirely with what is known of alkali distribution.

Again, an orchard quite free from evidences of alkali injury may gradually become affected in spots, which increase from year to year in extent; becoming, indeed, a very serious matter. This condition is commonly found in loose soils with an abundant water-supply, where there is a yearly rise in the average alkali level. This subject, and the whole matter of the treatment of alkali soils, is fully discussed by Professor Hilgard in another part of this report.

The third method of injury was first called to the attention of the people of the State by the Rev. Mr. Motheral, of Hanford. It consists in the accumulation of the alkali salts in or on the parts of the plants subject to greatest evaporation. Mr. Motheral's observations cover the effect of this in producing the dropping of grape blossoms and small fruit, generally known as "couleur." I have been unable to give this particular matter much attention; there is no doubt, however, that there is a great deal of dropping not referable to this cause. I have studied, however, certain effects on the leaves, which are quite evidently of this nature. The affected trees have much the appearance of trees burned by the application of a caustic wash. The edges of the leaves are burned and crisp, while that about the veins remains tense and normal. The roots do not lose their water-gathering powers; indeed, are quite healthy, and the effect appears to be confined to the exposed parts of the tree. This trouble is an extremely difficult one to prescribe for; perhaps the most feasible suggestion is the stimulation of new growth by irrigation, cultivation, or pruning, and also, possibly, fertilization, in order to have a larger evaporating surface.

The fourth source of injury is the peculiarly strong radiating power of an alkali soil. An extremely hot sun will burn the edges of the leaves, even of a tree in fairly good condition. This scorching is, of course, on the most exposed parts of the tree. In the very hot alkali regions it will be noticed that leaves, chiefly at the lower part of the tree, will show this injury; the reflected rays of the sun thus producing, under these conditions, a greater effect than the direct rays. The explanation is twofold: First, the lower leaves have the combined action of the direct and reflected heat; and second, the under side of the leaves is not able to resist as much as the upper side, being much thinner skinned and having more openings.

MOSS.

Trees exposed to the moist wind, and especially those where there is considerable fog, often become covered with a dense growth of various lichens, commonly called moss. These plants are generally supposed to be harmless, but it is a fact that trees so affected are always in a bad condition and yield diminished crops. Indeed, practical fruit-growers are so convinced of the injury due to moss, that they will often be more willing to spray for moss than for scale.

Some time ago one of our students, Mr. Blasdale, began the study of the nature of the effect of the moss, and read a paper before the State Horticultural Society, giving the result of his investigations. Further observations emphasize the facts brought out by his study, and support the common practice as being correct.

The effect of the lichen is the production of the condition of bark generally described as *hide-bound*. The plants do not confine themselves to the dead tissue of the bark, but encroach upon the still living portions, in some cases (viz., with the species with root-like base) forcing the production of layers of new bark, but generally resulting in the reduction of the growing layer to a dormant condition. On the smaller branches, this finally accomplishes the death of the bark and the consequent drying out and death of the whole stem. The greater thickness of the bark of the larger branches prevents this occurring there; but the result of the moss, even on the trunk, is a conspicuous roughening. An afflicted tree is more affected by droughts than is a clean one.

The remedy is a winter wash containing considerable caustic alkali. Most of those used in this State for scale insects, will accomplish the destruction of these also.

CURL LEAF.

This is a fungus which attacks the peach all over the United States, and is generally considered uncontrollable. Many in this State, however, obtain the best of results by the use of the common lime, salt, and sulphur wash, applying it in the winter the same as for scale insects. Experiments at the Central Station at Berkeley with a large number of washes, including the lime, salt, and sulphur, gave entirely negative results. In no case was there an appreciable difference between the treated trees and similar untreated trees, selected as checks. It may be that about Marysville, where the most satisfactory results are reported, the fungus has a somewhat different habit of growth. Under most circumstances, it appears that the fungus passes the winter within the tissue of the smaller branches and the buds, and grows out into the new leaves as they expand, and by its presence cause the thickening and wrinkling so characteristic of the disease. Where this is the history of the fungus, no winter treatment, nor ordinary summer treatment, could reach them. The fact that satisfactory results are obtained about Marysville, would seem to indicate that the fungus was not already within the plant at the time of application. It seems, even at Berkeley, where the experiments were of such a negative character, that the fungus is not so constantly present within the plant as is generally supposed. It seems to die out, and the stems, later, become re-infected. Everywhere it is recognized that the fungus does die out in the older tissue; but that it also dies out even in the youngest tissue, under some conditions, seems not to have been heretofore suggested.

This idea forms at present the only working hypothesis available for the treatment of the disease, and if it is correct the curl leaf is no longer to be considered uncontrollable, even under the worst conditions. Its control, under the Marysville conditions, seems to be the simplest kind of proceeding. Where this is not wholly satisfactory, the winter wash should be supplemented by summer treatments and the pruning-shears.

Any standard fungicide, like Bordeaux mixture, will certainly prevent the germination of the spores.

A number of treatments to cover the season of possible infection, and the removal and burning of the twigs most affected, should gradually reduce the trouble. Under the worst conditions, perhaps the winter treatment would become of little value, and, on the contrary, the pruning correspondingly more severe; the object being to prevent, by the summer treatments, the introduction of the disease into healthy parts of the tree, and the gradual removal of all infected twigs as they are replaced by healthy twigs derived from dormant buds in the older stems, in which the disease has run its course and died.

SCAB.

The disease of the apple and pear, known as *scab*, is very prevalent in this State; and, though well known and easily controllable, is, to judge from the letters received here, but poorly understood by the fruit-growers.

The spores of this fungus germinate on the surface of the leaf or fruit. The plant produced finds its way beneath the skin, growing and forming a spot not larger than could be covered by the end of one's finger, and remaining always very close to the surface. The fungus matures by sending up branches, which break through the dead skin of the fruit or leaf and produce a crop of spores. These are carried, by wind or other means, to another situation, where they germinate and produce other spots.

This history is almost identical with that of a majority of the fungi affecting plants.

The method of treatment is to cover the leaves and fruit with a substance which will prevent the germination of the spores. One of the best of these remedies is the well-known Bordeaux mixture. Nothing can reach the fungus after it is once in the fruit or leaf, but as there are several crops of spores in a year, it is quite feasible to prevent the largest part of the injury, even after one can see the spots of the first crop of the fungus.

The fungus does not spread through the plant, but each spot represents a different infection. The large spots often seen on fruit are produced by the combined action of a number of plants, each from a spore. The cracking of the scab, so common in the larger scabs, is due to the greater thickness of the layer of dead tissue formed in the combined scab spot.

The distorted fruit resulting from scab is produced by the earlier crops of the fungus, and the spots on smooth, full-sized fruit is the result of the late crops.

WIRE WORMS.

These insects, though not as troublesome as in the Eastern States, still cause considerable complaint.

The worm which, from the suggestiveness of the name, is recognized at once by every one, is the larva of the snapping beetles. A number of different kinds of wire worms are known, and a large number of the adult beetles; but scarcely any of them have been bred, and the kind of worm producing the various kinds of beetles determined. The length of life of the worm appears to be usually about two years, but most of the injury is done in the second year, during the last month or two of its existence.

There seems to be no remedy available against this insect; so that what is done must be of the nature of circumvention. The insect is most injurious under certain conditions and to certain plants, so that a clear understanding of the case may enable us to avoid loss.

The eggs are deposited in the ground by the adult beetle, and by preference, in sod or weedy ground. Thus, where there is land of this description, but little fear may be had if the fields are kept clean. Further, a field that is weedy for a single year, need not be expected to contain wire worms to a dangerous extent the following year, but should be looked after during the second, and, for some species, during the third year. A field in grass, or weedy for more than a year, is likely to be bad from wire worms during any one of the first three years planted to a crop easily injured by these insects. A careful examination made one year, will indicate the probable amount of wire-worm injury for one or two seasons.

A field is seldom badly enough infested with wire worms to have a bad crop oftener than once in two or three years, so that, by examinations and timing the change from meadow to hoed crop, one might quite avoid injury.

The method of examination of the soil suggested, is to select a number of small samples, and sift the same in a thin layer over paper, and carefully go over the same, looking for the worms. If the examination is made in the fall or spring, the large worms found will threaten the next season's crop, the small ones the second season's crop. In case there are some of intermediate size, they may mean either a small species or a species developing in three years, in which case the smallest may not be injurious till the third season.

One can only judge by experience, of the degree of injury to be expected, but a great abundance of any size of the worm should be considered a sign of danger ahead.

Local experience is the only guide as to crops likely to be injured. As a general rule, plants with an abundance of fibrous roots, like that of grass, are the least injured, while those growing from larger seed, like the small grains and corn, and those with a fleshy root, like many of the garden crops, and also cuttings, nursery stock, and young orchard trees, are among those most susceptible to injury.

In a region where the wire worm is prevalent, it would be well to make a careful examination in the spring, before selecting any ground for garden and nursery, whether the land had been clean or not; for sometimes the wire worms become prevalent even in ground which one would expect, from its antecedents, to have been clean from the pest.

The only other suggestion to be made is that good results may often be obtained in an annual crop in spite of the worms, when the other conditions are made the most favorable. The plant may be able to support the worms and bear a good crop at the same time. The advantages claimed so often to result from the application of fertilizers, may be ascribed to this reason.

CUTWORMS.

These worms are complained of all over the State, but appear to be most persistent in the lower San Joaquin Valley. I will quote from a number of letters mostly received from that district:

Mr. A. W. Johnson, of Fresno (April 3, 1894), writes: "I have a vineyard near Selma, which was partly destroyed by cutworms last year, and they are again making their appearance. * * * They did not disappear last season until the weather got very warm."

Mr. W. H. Shafer, of Selma, Fresno County (April 18, 1894), writes: "Cutworms are appearing in immense numbers in parts of Fresno County, and are doing great damage to raisin vineyards. The vines can be easily and cheaply sprayed with arsenites, but the leaves are very small at this time, and so smooth that the spray runs off."

Mr. C. M. Steinbeck, of Templeton, San Luis Obispo County (May 13, 1895), writes: "Our section is troubled with cutworms this season, for the first time, that is, to any extent; * * * they are cutting the leaves and young fruit in the orchards; prunes and pears the worst."

Mr. H. H. Harding, of Fowler, Fresno County (April, 1895), writes in reference to cutworms: "They kept my vineyard cut back last year until the last of May, and I did not get any grapes."

In regard to habits, we might classify the cutworms into three groups: (*a*) the ground worms, which work at the surface of the ground; (*b*) the climbing cutworms, such as are spoken of in the letters quoted above; and (*c*), the army worms, which work in the daytime, and in great numbers, keeping together. The same species may assume different habits, but, as a rule, a species confines itself quite closely to one habit of feeding.

The *ground cutworms* are best treated by the use of poisoned bait, consisting of bunches of grass, alfalfa, or other green stuff dipped in Paris green, and scattered over the field a few days before planting; the bunches might be lightly covered with earth. For field crops, is recommended the examination of the land in the spring, and, if infested, the planting of such crops as suggested for wireworms. The examination for cutworms is different from that for wireworms. These insects are annual, and the injurious species are mostly those that pass the winter as a nearly full-grown worm, and it is for these only that one need look. They are to be found by turning over clumps of grass, or other such plants, and shaking out the roots.

The *climbing cutworms*, like the ground cutworms, pass the day hidden in the earth, coming forth to feed at night. A few may be found on the plants during the day, but these are exceptions. They can be poisoned with Paris green, which can be most easily applied as a powder, about five pounds to the acre, in much the same way that sulphur is applied; if too much is used, the leaves may be injured. The injury from the worm usually occurs in the part of the year when new leaves are being produced very rapidly, so the application will have to be repeated from time to time. A great deal will be eaten before the worms are all killed by this method, but it is the most practical plan for use on a large scale. Hand-picking at night is sometimes resorted to, and for valuable plants, profitably so. Nursery stock is sometimes successfully cared for by jarring the worms into sheets carried between the rows.

The *army worms* are scarcely noticed, except when in excessive numbers; indeed, when not abundant, they have much the habits of other cutworms. When the army worm attacks a plant there is but little hope for the latter, and our efforts should be directed towards the prevention of their migration to other plants. The most direct method is to spray the worms with a strong insecticide, as kerosene emulsion, or the application to the infested field of a very strong dose of Paris green, say two to ten times the usual strength. The most common treatment, and perhaps the best, is the barrier plan: A furrow with post-auger holes at short intervals, if properly cared for, will prevent their passing from one field to another. A tar band will accomplish the same result, but it also must be watched and renewed.

WHITE ANTS.

Another root insect doing but little injury, but often observed, is the white ant. Mr. Theo. Wagner, of Orinda Park, Contra Costa County (February 25, 1892), writes in reference to it: "I send herewith a bottle containing a piece of a grapevine infested with insects, which eat out the heart or pith of the vine. I have noticed quite a number of my vines infested in that way."

The insects are somewhat ant-like, and dirty-whitish, with hard, pale-yellowish heads. They enter the vine through a stub end of the cutting or where a large root has been cut off, burrowing out the pith, not only in the dead wood, but also for some distance into the healthy parts of the vine. It does, practically, no injury.

VINE-HOPPER.

The vine-hopper is a well-known pest, most peculiar in its periodicity, being usually rather rare and then coming in great numbers. Mr. C. E. Mack, of Sacramento (June 3, 1895), writes: "I have a twenty-five acre Tokay vineyard, which is badly infested with the jumping vine-hopper. The leaves are turning yellow, and soon will fall and leave the grapes exposed to the sun to burn. It is a dreadful pest, and I want to check it. Paris green and sulphur have failed to check it."

The most promising method of dealing with this insect seems to be the inverted hopper-dozer. This consists of a large, flat plane, mounted on wheels or carried by two men. It is to be covered on the underside with very sticky tar, and as it is carried over the vines the hoppers will fly and be caught in the tar. The contrivance can be made arch-like, if desired, instead of flat, and it may be found useful to hang something below, which will scare up the insects. This method is only useful against the full-grown insects; but, as they are long-lived, it is worth while to try to kill them, even for the saving of the crop for the current season.

TETTIGONIA.

Last spring our attention was called to a vine-hopper on the place of Mr. John T. Doyle, at Cupertino, Santa Clara County, which, on investigation, proved to be a very different insect from the ordinary vine-hopper, and nothing else than the common omnivorous Tettigonia. The insect has been noticed for quite a number of years, as injurious, in the neighborhood of Mountain View. The extent of the injury possible from this insect may be known from the fact that in 1894, on a field of fourteen acres, less than a tenth of a crop was produced, and scarcely any growth of wood.

The appearance of an infested field is very striking and characteristic. There is a partial atrophy of the veins of the leaf, causing them to curl and wrinkle, quite equaling in extent the curled-leaf lettuce. I know of no other member of the family, nor of any closely related family, that produces this curling effect on a plant; and this insect does not do it on other plants.

The insects, while feeding, exude a large amount of fluid material, sufficient to keep the ground wet beneath the trees upon which they may be feeding. On the grapevine they are not generally abundant enough to produce this result. They pass the winter as adults, and migrate to the grape in the spring, where they lay their eggs. I have never seen the egg, but the young appear on the vines, in company with the old insect, about the end of May. The hoppers are very active, and fly almost horizontally, and when a vine is disturbed they commonly fly to the next one.

This insect cannot be satisfactorily treated by the method recommended for the vine-hopper; but one peculiarity of the insect makes the treatment simpler than for that insect. At night, when disturbed, they fall to the ground. This is true of the adult, but not of the young to so great an extent. The adult insects may readily be killed by jarring them to the ground and treating them to resin-soap mixture distributed by means of watering-pots.

PEACH MOTH.

The peach moth, or peach borer, as it is occasionally called, is generally very well known over the State. It is very abundant, and does a good deal of injury. I quote from a letter from Mr. A. N. Burch, of Oakdale, Stanislaus County (February 26, 1894): "My peach orchard has suffered somewhat from an insect, a minute moth, which feeds on and is found in the center of the new buds, appearing first just as the buds are bursting into leaf and bloom."

I only mention the insect to call attention to a point in the life-history of the insect, which is not so widely known, but which indicates the true remedy for the pest. It appears that the young larva attacks the branches of the tree during the winter, eating through the bark and causing a drop of gum to exude in a number of places, before it attacks the bud in the spring. The proper remedy, therefore, would be to poison the bark and the outside of the branches during the winter or towards spring; thus killing the insect before it does its chief injury by attacking the buds.

The winter wash, lime, salt, and sulphur, is said to be a perfect preventive; and I have no doubt that Paris green will be also effective.

APPLE-TREE BORER.

The flat-headed apple-tree borer often becomes quite injurious, especially in exposed situations.

Mrs. F. E. Mallory, of Dundee, Los Angeles County (February 15, 1894), writes: "For two years I have lost a great many dollars' worth of trees, and have found that it is owing to the borers. Last year we wrapped the trees with cloth as early as the middle of May, but it did no good. * * * What I call the borer is a crinkly, white, worm-like creature, with a large, flat head."

Mr. E. E. Barnard, of Mount Hamilton, Santa Clara County (September 17, 1891), sent samples of "fruit trees which had been killed by a white worm with a large, flat head, that eats the tree between the bark and the wood, and burrows into the heart of the tree. * * * I supposed it was the hot weather that was killing them. I kept the trees well watered all the time. * * * Among my trees was a cork elm, which I have had three years. It, too, was attacked, and is essentially dead. * * * Under the bark, everywhere, was a coating of powder-like substance, one eighth of an inch thick."

This insect lays its eggs in the crevices of the bark, scarcely ever selecting a smooth-barked tree, and usually in trees that are badly cracked. The young insect bores to the cambium layer, and spends most of its life in reducing this to pulp. A tree badly attacked soon dries out and dies. Trees should not be allowed to become attractive to the beetle. The greatest danger lies in the tendency to sunburn in the newly set orchard. This is prevented by wrapping, by the use of whitewash, and by driving a stake so that the trunk will be shaded at the hottest part of the day.

In case a tree should have become affected, but little can be done. It is best, perhaps, to remove the insect as soon as seen, and wax the wound, and thus facilitate healing. It is very hard to save a tree, so injured as to be attractive to the borers, in regions where the insect is very prevalent.

TWIG-BORER.

The twig-borer, attacking chiefly the olive, is the borer most often sent to our department.

Mr. A. T. Morris, of El Cajon, San Diego County (April, 1892), writes:

"I inclose to you an olive cutting, being the body of a yearling tree, about two feet from the ground. It contains the work of a borer; at least, what I suppose to be a borer. It will contain the bug itself, if it does not get out before it reaches you. Several of these trees have been cut so nearly off that the wind breaks them down."

The insect enters the twig at a bud just above a leaf, and burrows down the center of the twig.

The only remedy that has ever been suggested is the destruction of the beetle, whenever found; but such a procedure would not be worth anything, if, by some chance, the insect becomes numerous enough to be seriously injurious. We are at present in entire ignorance as to the life-history of the beetle. We do not know where nor when the eggs are laid, nor upon what the larva feeds. It is a matter for which every olive-grower should be on the lookout, because at any time the insect might become numerous, and do much injury to our trees.

JOINT WORM.

This old enemy of the wheat does not seem to have been very troublesome of late years. It is generally not understood by farmers.

Mr. E. F. Smith, of Sacramento (May 26, 1895), called our attention to it during the past year. He writes: "I send you, by this mail, a sample of wheat taken from the field of Mr. John Reith, near Union House P. O., in Sacramento County, that was brought to me for examination as to the cause of its disjointed appearance. You will observe that some character of insect has been at work upon the joints of the plant. The growth of the same has not been retarded in the least, and the grain, as will be observed, has a healthy look, but in the progress of growth some enemy has attacked the joints for some purpose, thereby so changing the course of development as to give the plant the shape you now find it. By close examination of the joints you will find their appearance not unlike a tree graft."

The straw was regularly and uniformly bent, about 30° at each joint, giving it a very peculiar appearance. Within each affected joint the worm could be noticed, seldom more than one at a place. Though these particular specimens were otherwise in a good condition, the attack of the worm usually greatly decreases the yield of the stalk, if not entirely preventing the development of the head.

The insect has but one brood a year, and passes the winter in the straw. The straw from badly infested fields should, therefore, be burned.

PRUNE APHIS.

One of the most serious prune insects is the prune aphis. Mr. C. L. Peterson, of Calistoga, Napa County (July 10, 1892), writes: "I herewith send you specimens of what I call a kind of an aphis, which infests prune trees, and particularly the French variety. They seem to be worse in this and Sonoma Counties than usual. * * * I think they affect a tree in about the same way as the scale does, if not a little worse. They first appear about the last of May, and last until the middle of July."

This insect generally causes the leaves to curl, and it then becomes difficult to reach it with an insecticide. It is very easy to kill with kerosene emulsion or resin-soap mixture, but must be attended to as soon as seen, and before they are protected by the curled leaf. The insect is very subject to parasites and to disease; and if they show abundantly, the spraying may be very safely omitted.

BLACK APHIS.

This is an Eastern insect, and occurs in many parts of the State, but does not seem to be any more injurious than in the East, where, though occasionally abundant, it is generally rare. I believe that Horticultural Commissioners have discovered the aphis a number of times, and used the most heroic measures to rid the State of the pest. Mr. J. C. Moody, of Alma, Santa Clara County (November 29, 1892), writes, in reference to it: "I bought some peach trees that were infested, and have managed to get the best of the insects with a resin compound; but find some around the body of a few young trees below the ground."

The treatment of the insect is simple, and the same as for other aphids; except that some of the wash should be poured about the trunk, on account of the habit which the insects have of descending below the surface of the ground.

WOOLLY APHIS.

The woolly aphis is a much more difficult insect to eradicate than those living above ground, but it is a much easier insect to control than such as the phylloxera. The treatment above ground is the same as for other aphids. Those on the roots are beyond the reach of any practical remedy, but fortunately they do but little injury. The danger from this insect lies almost wholly in their attack upon the crown of the root. At this point the irritation by the insects causes the tree to attempt to put out suckers. These, generally, are not able to develop into a normal sucker, but remain as knots on the tree. The continuation of this process finally produces a very large knot of abnormal tissue around the base of the tree. As long as this tissue remains alive, there is no danger to the tree, but it generally dies, and may then be the avenue for the drying up of the trunk, and causing the death of the tree. The most serious complication is the rotting of this tissue and the admission of toadstool fungi, which will ultimately result in the death of the tree.

The remedy is simple, and consists of defending this part of the tree by wood ashes or other substances distasteful to the aphis.

YELLOW JACKETS.

The common yellow jacket, usually called the wasp, is often very destructive to pears, and especially to apricots. Mr. J. W. Aytoun, of Santa Cruz (September 19, 1891), reports the wasps as completely destroying the fruit on an acre raspberry patch. "As soon as the fruit begins to redden, it is attacked. These pests are exceptionally bad this season, and never caused trouble in this manner before."

This insect passes the winter singly, hiding in any convenient place. In the spring, an old gopher-hole, or something of the kind, is selected, and a nest constructed of paper manufactured by the insect. Soon a considerable colony is developed, all the children of the one insect founding the colony. The food for the young is chiefly other insects, which are destroyed in great numbers. The full-grown wasp has a fondness for fruit, however, so that while the insect is otherwise useful, it must be destroyed when abundant. The only practical method is the search for, and destruction of the nests. The best way to exterminate a nest is to visit it late at night and pour into the opening a quarter tumbler of carbon bi-sulphid; a little dirt might be thrown over the hole to confine the fumes. If the nest be examined the next morning, all the insects will be found to be dead.

DIABROTICA.

No insect has been complained of with so much persistence as the so-called green ladybirds. Mr. C. W. Hunter, of Bryson, Monterey County (June 4, 1891), sends "bugs that are destroying the peach trees. * * * They eat the leaves off, and then go to another and serve it the same way."

Mr. G. W. Wright, of Oakland (July 13, 1891), writes: "Apricots are just ripening, and are honeycombed by insects. * * * These, the children tell me, are 'lady bugs'; they infest squash vines, sunflowers, corn, and every green thing or flower in sight."

Mr. W. C. Bradford, of Arbuckle, Colusa County (March 21, 1892), says: "I send you some bugs which make it almost impossible to raise any vegetables here, except peas, beets, and a few other things. They also do much damage to fruit."

Mr. H. B. Jones, of Arbuckle (June 26, 1891), sends specimens of an insect that "makes it simply impossible to raise any vines of the squash family, cucumber, cantaloupes, etc. They work only on the leaf, leaving it perfectly skeletonized, but do not touch the root or any other part of the vine."

Such letters are continually coming. Generally, nothing is done towards destroying the pest, as it is looked upon as useless. While the diabrotica is an unsatisfactory insect to attempt to destroy, it is not wholly uncontrollable; perhaps if we knew more of its life-history, it might become comparatively easy.

In the flower garden the daily use of a sweep-net will enable one to destroy a large enough proportion of the beetles to greatly decrease the amount of injury.

For protecting the orchard, the problem is more complex. The use of a sweep-net will generally not be profitable. It may be that by jarring the insects from the tree onto a sheet each morning, after they have begun to attack the fruit, would be found profitable. For this purpose, the sheet could be stretched over a frame attached to a wheelbarrow, and with a slit for the trunk, so it may be brought under the tree; or, perhaps, better, two sheets on wheels, each to take one half the tree. This would require the work of two persons. The jar may be given with a mallet well padded so as not to injure the bark.

The most promising measure, however, is the use of Paris green to poison the beetles. This, of course, cannot be applied to the ripe fruit, for fear of rendering the fruit poisonous to man as well as to the insects.

During the greater part of the year the beetles feed chiefly on the leaves of plants. They also have great preference for certain plants, notably certain varieties of peaches and apricots. On such it is possible to destroy a great number of the beetles by keeping the plants dusted with the insecticide. If there are none which are particularly chosen by the insect, it would be profitable to plant something to be used for traps. For a large number of insects, the use of decoy plants is the most promising method of treatment. I believe it will be well worth while for nurserymen to select and develop varieties, or strains of plants, peculiarly susceptible to the diabrotica, for instance, to sell as decoy plants.

NOTOXUS.

Some six years ago Mr. J. P. Jones, Horticultural Commissioner at San Diego, called the attention of the department to the work of a small beetle in apples, which proved to be *Notoxus monodon.* Professor Riley, to whom the specimens were sent, doubted very much if the injury was done by the beetle in question, but observation showed that it actually did produce the hole. The insect is known in other parts of the State, but we have not seen the injury in other sections. The insect appears to be ordinarily a borer, working into the pith of the cut or broken ends of twigs. It certainly cannot have been injurious in most parts of the State; but it is an insect which may be looked out for and gotten acquainted with. It is about an eighth of an inch long, of peculiar shape, and may be found by splitting a twig which shows a hole in the end, where it was cut off in pruning.

CORN WORM.

The Sacramento Packing and Drying Company writes, under date of January 12, 1894: "The sugar corn consumed in this State is brought out from the East, to a large extent, while, if it were not for this pest, corn-packing would be quite successful and extensive within our borders. We are assured by people having experience, that it is well nigh impossible to get sugar corn not having a worm in the ear." This is the same condition of affairs that is found in the Southern States, where the insect is more commonly known as the "boll worm," on account of its attack on the bolls of cotton. In the Northern States, the worm also exists, but the shorter season prevents the many broods that are found in the South; the corn also matures faster, so that the worm never becomes as abundant nor injurious. It may be that in California the corn, for packing purposes, will have to be grown mostly in the foothill regions, where the climate corresponds with that of the Northern States. For market garden purposes, the solution is the growing of the most rapidly developing dwarf varieties.

It may be that dusting the field with Paris green repeatedly, just before and at about the time the silk appears (which corresponds with the period of the entrance of the worm), may produce results. We have suggested the experiment to a number of correspondents, but have not heard of the results obtained.

LEAF-CUTTING BEES.

The work of these insects has often been brought to our attention from the vicinity of Visalia, but as yet we do not know the name of the species concerned. The insects chiefly attack rose leaves, carefully cutting out round or elongate bits from the leaves, sometimes almost defoliating a vine; they seem to have a decided preference for certain varieties. The bits of leaf are used in making their nests, which they construct in all sorts of situations. A number of nests inside of split peach pits have been sent to us at various times.

Mr. G. W. Stewart, of Visalia (September 1, 1893), describes the appearance of one found by Mr. Charles Riley of that place: "Mr. Riley noticed that the peach had a split pit, and ran his knife around it, when it fell open, disclosing two small sacks made of leaves in the center of the pit. These are made of fragments of peach leaves cut as if to a certain pattern and stuck together; small pieces are glued in to form the ends. There were also pieces of leaves, evidently intended to make another sack. These were drawn into the peach through a narrow aperture, and the sacks made inside."

NOTES FROM THE ENTOMOLOGICAL LABORATORY.

By C. W. Woodworth.

We will describe, under this title, a number of devices which have been designed and tried in this laboratory, and which will be found of use to students of entomology.

A Folding Net.—The ordinary insect net is too large to be conveniently carried about, so many folding nets have been devised. The simplest and most satisfactory net of this nature is one consisting of a tin ferule, a strong clock-spring hoop, and a thin muslin bag. The tin ferule is about six inches long, and tapers from one inch in diameter down to less than half an inch; this serves as a handle to the net for beating and sweeping, and will receive almost any size of stick when a long handle is desired. The hoop is of the ordinary size, with the ends firmly soldered into the small end of the ferule. The folding is accomplished by grasping the hoop at the point farthest from the handle, and pulling it over, when the spring will suddenly snap into place, coiling itself up into a hoop one third the diameter of the opened net.

A modification of this net consists of a ferule made from a cartridge-shell fitted to the end of a stick. The loose ends of the net-hoop extend through this, and are held firmly between the stick and the ferule. The advantage of this form is in the ability to remove the bag of the net, but hardly compensates for the inconveniences of the loose parts.

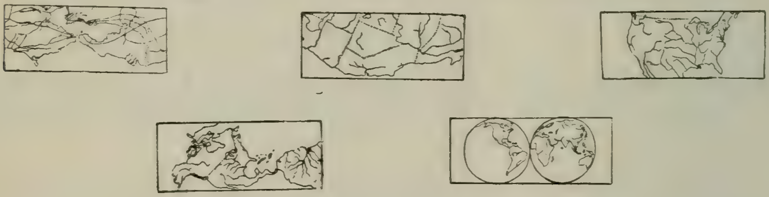
Setting-Board.—We have used for several years a form of setting-board, which appears never to have been described. It consists of a plain ¾-inch board, with awl-holes of a size to take the head of the insect-pin used. In mounting, the head of the pin is inserted into a hole; this brings the back of the insect against the board. The front wings are now brought into position and fastened down, then the hind wings, and lastly the antennæ and legs. A very few insects require a very shallow groove for the body for the best results. Besides the simplicity of this board, it puts the insect in the most satisfactory position for setting every part.

Labeling.—We have recently adopted a set of labels for our collection, which are expected to be very useful for the study of geographical distribution. We have two sizes—one for small insects, and for genus and species labels for the bulk of the collection; and a large label, for groups larger than the genus, and for genus and species labels for the groups containing insects of the largest size.

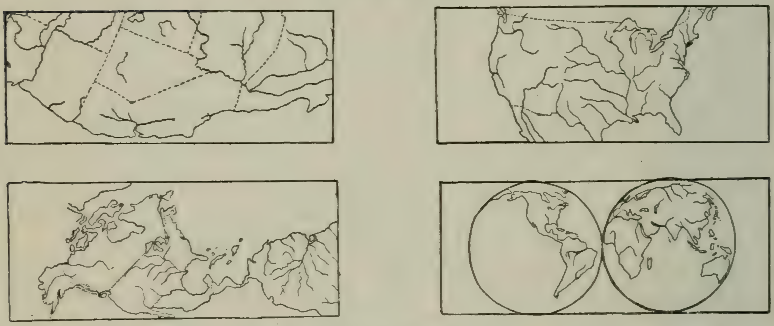
The labels consist of map-sketches, printed in pale ink, upon which the locality of the insects in the collection will be indicated by a dot. As the collection grows the label will become a distribution map of the species, genus, or larger groups.

The large and small labels, as will be seen, are exactly alike, except in size.

The exact label chosen for a species will be the one covering the least territory which will include the probable range of the species. If it is found that it extends beyond the countries shown on the label, the next one is taken and the dots transferred.



Small Labels.



Large Labels.

Insect Box.—We have found means of constructing a cheap and very satisfactory all glass and metal insect box. The box consists of two sheets of glass 8 x 12 inches, and four strips of tin 4 inches wide, two of which are 9, and two 11 inches long. The short strips are cut as follows: One inch from each corner, on the narrow side, cut parallel with the long edge 1 inch; now from each corner cut diagonally to the end of the first cut, removing a triangular piece. A strip an inch wide, of all the pieces, is now bent back at right angles along both long sides of each of the four pieces. These bent portions are again bent back upon themselves, leaving a space just wide enough to receive the edge of the glass. The box is now ready to be put together, which is accomplished by slipping the glass into the grooves provided for it, and by bending down the ends of the short strips.

PLATE I.

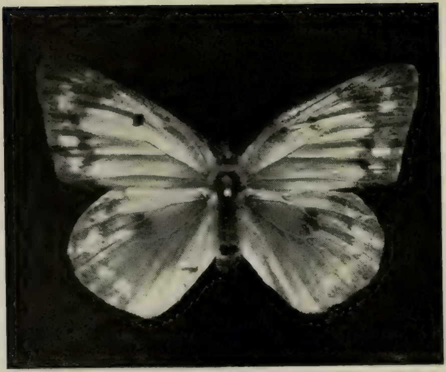


Fig. 1.

Colias philodice, Godt, female. Natural size.

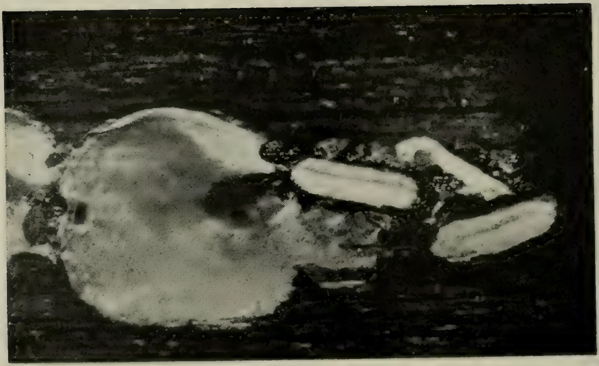


Fig. 2.

Diaspis rosæ on Raspberry, female, males, and young. Enlarged about sixteen times.

The box is opened by removing one of the short strips. The insects are pinned to a cork sheet of a size to just fit the box, and slipped out and in as wanted. For butterflies, a frame with a delicate wire net, to which minute corks are attached, may be used for pinning, and thus permit the examination of the insects from both sides.

The box can easily be made very tight, and, for exhibition purposes, may be sealed with a little paint and be absolutely tight.

These boxes may be set edgewise on a shelf, and may be tiered up several boxes high; and, if made to "break joints" with each other, one can be removed from any part without disturbing the others.

Photographing.—On Plate I is shown two half-tone illustrations of insects made from photographs taken in our laboratory. It is our intention to illustrate in this way, as fast as possible, all our common insects. One of the difficulties met with in photographing insects is the want of detail. In the usual method with a white background, the background and the edges are over-exposed long before the disk is sufficiently brought out. We have been able to overcome part of this difficulty by doing away with the background almost entirely. It is not enough to place a black background behind the insect, for the blackest substance reflects a great deal of light. If fine black cross-wires are stretched across a frame and a cork attached to these, upon which the insect is pinned, and the direct sunlight allowed to shine upon the insect, with also the reflection of light from a couple of mirrors, the background, as seen in the camera, is absolutely black. The mirrors overcome most of the shadow effects, and the insect stands out in beautiful relief.

In Fig. 2, which is a micrograph, we have another direct sunlight picture, but of course with a background.

A Dissecting Dish.—A very simple and satisfactory dish may be made by wrapping a strip of paper around a large cork, allowing it to project about half an inch above the cork, and fastening it with a pin. Now pour into it a very little melted wax or paraffine, and turn the dish around as it cools, so as to cover all the inside of the dish, including the paper. The dish will now hold water, and the cork bottom is just right for pinning the insect down. The cork may first be painted any color, if it is desirable to have any particular background upon which to dissect.

Tray for Slides.—In the preparation of slides, it is often useful to hasten the hardening of the balsam by applying a gentle heat. We have devised a tray for this purpose, which is simple and satisfactory. A piece of tin, or other metal, 3 x 5½ inches, is used for a tray. A strip half an inch wide is bent back at each end 180°. Placing this in a vise to the depth of one fourth of an inch, bend the tin at right angles, so that the strip first bent forms a T across the end. Do the same at the other end. After making a number, make the last bend a little more than a right angle, so that the trays will nest one above the other. The tray thus constructed is three inches square in the clear, nests perfectly, holding the slides one fourth of an inch apart.

Labels for Slides.—Instead of labeling slides in the usual manner, we have found it to be very satisfactory to write the number in very small characters on a piece of thin tissue paper and mount this beneath the cover with the object. The paper becomes almost transparent, but the number remains clear and distinct. The number becomes thus a part of the preparation, and cannot be effaced or destroyed. It is very seldom that there is not room under the cover for the number. This method becomes especially useful for preparations mounted between two cover-glasses—a method of mounting which deserves to be almost exclusively adopted for mounts of whole insects, or of their appendages.

Slide for Cover-Glass Mounts.—Many are deterred from mounting objects between covers because of trouble in studying them under the microscope. They need some sort of a holder to make them available. We have used, for this purpose, a glass slip perforated in the middle with a round hole a half inch in diameter; such a slip can be obtained of dealers in microscopical supplies. On one side two or three drops of balsam are dried onto the slip, at such spots as to hold the preparation between them and bring it over the hole in the slip. For larger cover-glasses the mounts should be so arranged that the cover-glass will lie somewhat to one side, so that all parts of the preparation may be brought over the hole.

Books for Cover-Glass Mounts.—For storing cover-glass preparations, the most compact device is the use of the book used in this laboratory. The cover is 1 x 3 inches, and fits into the ordinary mailing-boxes; the leaves are $1\frac{1}{4}$ x $2\frac{1}{2}$ inches, with the $\frac{1}{4}$ inch folded up. Slits are cut in the pages in such position that the preparation is held between the slit and the folded-up part of the page. Two or three preparations go on a page, and a 25-slide box will hold 500 preparations. The precaution must always be taken to have the balsam well dried, so it will not work out and smear the book. The numbers corresponding with the slide can be placed on the folded edge, and fuller data on the page itself beneath the preparation. The back of the book is put in first, so that all the numbers may be seen without removing the books from the box.

Racks for Bottles.—A bottle-rack, designed in this laboratory for bacteria work, is now used for homeopathic vials for all purposes. It consists of a piece of tin 6 x 8 inches, bent like an inverted V. A strip an inch wide at the lower end, on both sides, is bent out at right angles, and then upward, forming grooves, in which the bottles fit snugly; at both edges the tin is bent up slightly, to prevent the end bottles from falling out. The arms of the inverted V may be spread out till the bottles are nearly horizontal, or they may be closed together till they stand upright. The rack will hold sixteen two-dram, short homo vials; and, of course, more of the smaller sizes.

A Pocket Compound Microscope.—The occasional need of a compound microscope on a trip, when it is not practical to carry the heavy instruments used in the laboratory, caused us to plan one that would be as light as practical. We obtained a tube from a Bausch & Lomb library microscope, and fitted it with a 1-inch eye-piece, a $\frac{3}{4}$-inch and a $\frac{1}{5}$-inch student's series objective, a special stage, and a spring clip, and packed them all within the tube, making the outside dimensions 5 inches long by 1¼ inches in diameter. The stage consisted of a brass ring, with projections reaching back and clasping onto the objective. The object is mounted between two covers, and fastened to the stage by the spring clips. Coarse adjustment is accomplished by moving the stage; fine adjustment, by the draw-tube. Illumination is had by pointing the tube towards the light. The instrument is quite satisfactory for practical use.

THE BLACK SCALE.

By C. W. Woodworth.

No insect has been more constantly before the people of the State than the black scale. It is considered by many as the worst enemy to fruit trees with which we have to deal. The insect occurs all over the coast region of the State, even extending through the greater part of the interior region, but becomes less and less abundant and troublesome as the dry, hot valleys are reached.

Description.—The young insect, as it is first seen upon the leaves of the plant, is a very small, flat, pale-yellowish body, moving sluggishly over the plant, or stopping to feed. Its only appendages are a large beak, six relatively small legs, and two somewhat smaller antennæ. These are all hidden beneath the body as the insect stands on the plant. Besides these, there are two quite conspicuous eye-spots, which doubtless serve for sight, but which never become developed into true eyes. All around the body there is also an armament of spines, quite regularly placed on the margin of the body. Those at the posterior angles of the prothorax and metathorax are arranged in a group, and clearly mark out these regions. At the posterior end of the body the hairs are longer, and we find a very peculiar structure—the anal plates. These are large, triangular, and distinctly chitinized, and drawn deeply within the body; or rather, the body has developed to a considerable extent on each side of the anal plates. There are six extremely long, strong spines lying within the alimentary tract, but which can be protruded entirely out of the body when they assume a star-like radiation. This protrudable portion of the digestive tract seems to be associated with the power these insects have, in common with many other Hemiptera, of throwing out their fluid excrement with considerable force, so that it does not accumulate about the insect.

Habits and Life of the Insect.—The insects are capable of walking a long distance, and may live for days without food. Under ordinary circumstances, they do not walk much, but quickly settle down on a suitable part of the plant and insert their beaks for food. The young insects scarcely ever migrate from plant to plant, but are probably chiefly dependent upon accidental circumstances; for instance, upon being carried on the feet of birds, or by such means. They may exist for years on one tree, and be absent from another immediately beside it. The insect at this stage is very easily killed by dryness, and probably a hot wind, such as is so common in California, just at the right time, would destroy them, even though the insect had begun to feed. As they increase in size, they are less and less able to move, and after becoming convex they lose this power altogether.

The youngest insects are by far the most abundant on the leaves; a few, however, seem to be able to penetrate the bark of the stems with their beaks. On plants in which the stems remain green (such as citrus), a larger proportion attach themselves on these stems than on those of other plants, but never equal, in numbers, those on the leaves. As the insect grows older the proportion on the leaves rapidly decreases, until, by the time they have become immovable, scarcely any can be seen, except on the stems. Thick-leaved plants, like the oleander, are exceptions to this rule. Only a small number, relatively, return to the stems after settling on the leaves, as at an early period there is almost invariably a great mortality, amounting to scarcely ever less than 90 per cent. It is very difficult to say whether this is as great among the insects on the stem as among those on the leaves, because of the migration towards the stem. The death-rate must, however, be nearly if not quite as great.

Cause of Death.—The cause of death is traceable to the attack of a number of diseases. These are quite similar to, if not absolutely identical with, the diseases that attack the chinch bug in the Mississippi Valley. As in the case of the chinch bug, sometimes we find one disease, sometimes another, and more often a combination of diseases. I have never known of the presence of ladybirds, or their larvæ, in any considerable numbers, in trees infested with black scale, excepting the *Rhizobius;* and in this, so far as could be made out, the dead or diseased scale were eaten by preference, if not entirely, by the beetle. No other insects, nor anything except the fungi and bacteria causing the diseases, can be looked upon as accountable for the phenomenal decrease that occurs before or at about the time of the first moult. Occasionally the high mortality continues after this period, even causing the practical extermination of the insect; but usually the insect is comparatively safe after this period, and further development continues without incident until the eggs are laid. During this latter stage, birds sometimes knock off a good number of the scale, especially if it is so abundant as to cover much of the stem between the buds.

With other species, and in the southern part of the State (even with the black scale, also), this stage is attacked by a native parasitic wasp. The eggs are devoured, and, after completing its development, the wasp makes a round hole through the back of the scale, and escapes.

Sometimes the young insects and eggs will become diseased, and die before any of them leave the old shell. This, together with the parasite, has, during the past season, destroyed an immense number of the black scale in all that section of the State between Los Angeles and Riverside, and there seems to be every promise that the coming season will see a wonderful decrease in the prevalence of the scale over that whole country, perhaps in places amounting to complete eradication.

Black Smut.—During the development of the insect it exudes a copious discharge of a fluid substance, which, falling on the leaves and fruit below, holds and fixes the dust which accumulates, and affords a starting-place and food-material for the development of various fungi, especially of the species known as the "black smut." This secretion begins to show its effects about the time of the beginning of the second stage, and continues to be produced until the time of egg-laying. It is not produced with regularity, seemingly sometimes to be associated with moist weather, but certainly not uniformly so. On some plants, or at some periods, the secretion produces no appreciable effect; and at other times, or on other plants, the appearance of the tree is dirty in the extreme. Thus on olives equally affected by the scale we find a great range of dirtiness. Orange and lemon trees, as a rule, are very much blacker than pittosporum. These peculiarities are not confined to the black scale, for the pine scale, which usually secretes a material very attractive to bees and flies, and often becomes a source of honey, will sometimes come to maturity without secretion enough to reveal its presence.

Species of Scale.—The black scale is almost everywhere associated with some other species of the genus, and the great variableness of these insects makes it especially important to make out carefully the distinguishing marks of the species. This part of the work has been very acceptably done in our laboratory, and forms a part of this report. The idea has been very prevalent among entomologists that the species of these insects are confined more or less to particular plants, and the difference observable in the general outward appearance of the same insect on different plants has given much ground for this supposition. The study has brought out the fact that the actual number of species of these insects is very small; that the species have, as a rule, a great range of food plants and of general appearance, and that even the species that seems to be most strictly confined to one host-plant will sometimes thrive on very different plants.

The characteristics that are generally relied upon for description of species are of very much less value than others which are generally quite disregarded. Not only in the description of species is this the fact, but a number of genera have been proposed, based on that poorest of all characters, the general outline, by means of which some of the closest allied species are separated, and some of the most distant united. Indeed, the "latest" classification leaves the group in a most unsatisfactory condition.

The most primitive species in general shape is *L. hesperidum* (Plate II, Fig. 3); it is decidedly larva-like, and can be looked upon as near the starting point of the genus.

The first species to differentiate was *L. tessellatum*, and the character most conspicuous is the arrangement of pigment in the peculiar reticulations shown in Plate II, Fig. 2. It consists of the fixing and elaboration of the pigmentation common to the larva of all the species.

The other species seem to have arisen from a form like *L. hesperidum*, which became first thickened and convex, in which the body-wall becomes necessarily hardened. From this *L. oleæ* (Plate II, Figs. 4 and 5; Plate III, Figs. 1–6; Plate IV, Fig. 1) differentiates by the development of two transverse and one longitudinal carina, and by a very remarkable development of the pits of the skin. These ridges are merely stiffenings of the primary pigment-lines of the larvæ, which are commonly in larvæ of all species more or less thickened. The carinæ can often be traced in the adult of other species than *L. oleæ*, but nowhere is it distinct; and in some abnormal individuals of *L. oleæ* even they become quite faint.

The skin-structure, which is fairly primitive in *L. hesperidum*, is but little modified in *L. tessellatum* (except in the arrangement of the pits), and becomes most highly differentiated in *L. oleæ;* this character can be looked upon as the real basis of this species.

L. hemisphæricum (Plate IV, Fig. 2) is a very slightly differentiated species, being in some respects almost as simple as *L. hesperidum;* but, by the large size of its pits, it shows a distinct development in the direction of *L. oleæ.* The peculiar structure along the median line is its most striking characteristic. All the carinæ of *L. oleæ* are often distinguishable.

L. pruinosum (Plate IV, Figs. 3–6; Plate V, Figs. 1–3) is the most variable species of the lot; the tendency it shows towards pruinoseness, and the close approximation of some of the specimens to *Chermes* in general appearance, indicate this peculiarity.

The variety *chermoides* varies from forms almost as convex as *L. insignicola*, to some but little thicker than *L. hesperidum.*

L. insignicola (Plate V, Figs. 2 and 4), though very close to *L. pruinosum*, is still one of the most easily recognizable species. Here we find the tendency to convexness carried to its extreme, and the insects becoming almost spherical. The skin becomes peculiarly hard, even brittle, when old, and there is no species in this genus where the shape conforms so closely to its surroundings. This insect is so striking in its general appearance that it is generally classed in another genus, but if *Lecanium* is to be split up, it is *L. tessellatum*, or *L. oleæ*, that should be separated off, and never *L. insignicola.*

ECONOMICS OF THE SCALE.

The consideration of the economics of the black scale involves many interesting questions. It is conceded by all that the insect does an immense amount of injury, and the question is, what is the most profitable course to pursue in reference to it? Upon this point, there is the greatest divergence of opinion. Some are in favor of extermination at any cost, and from this extreme all shades of views are to be found to those who contend that nothing can be done that will pay. These extreme views represent different conditions, and are the result of a failure to comprehend all the factors of the problem. The truth certainly lies between them, and a careful consideration of the facts will go a long way towards harmonizing the various conceptions of the case.

Injuries Done by the Scale.—The injuries done by the black scale may be divided into three classes:

(1) That occasioned by the withdrawal of the sap from the plant;

(2) The injured tissue resulting from the punctures of the insect; and,

(3) The excretions of the insects, with the accompanying injury to foliage and fruit by the accumulation of dust and the growth of fungi.

Each of these must be taken up in detail.

The loss of sap involves the loss to the plant of a certain amount of food-material and of water. The seriousness of the loss depends upon the number of scale insects, and the condition of the plant. The exact amount of sap extracted cannot be estimated with any degree of exact-ness, but must be many times the weight of the insects. The weight of the insects is not as much as one might imagine; they may amount, on an orange tree, to the weight of an orange, or possibly two or three, if a large tree and badly infested. The loss of water is probably more than that evaporated from that amount of fruit, and the loss of food-material also larger; but taking the amount at double, the loss from this source might be equaled by removing, say half a dozen oranges early in the season.

This does not cover all the damage, even of that referable to the loss of sap. The normal evaporation from the leaves is regulated by the guard cells of the breathing pores. By this means the tree loses its water gradually by evaporation, and more or less uniformly, and is able to resist, to a great extent, the dryness of midday, or of a wind. The water exuded by the insect has not this check, and the sap continues to be pumped from the plant when it can least afford it. Affected trees are thus much less able to resist the effects of droughts, and, under conditions normally quite favorable to the plant, may show all the signs of a dry season. The growth is checked, and the leaves become prematurely yellowed, and the loss is all out of proportion to the actual amount of water extracted. This result, it must be remembered, only occurs when the water supply is rather scant—when the tree is, as it were, speculating on a narrow margin. When the earth is moist, and the root hairs are well developed and are well equal to supply the call for water made by the top, then injury by the scale becomes almost nothing.

The second class of injury by the black scale, viz., that caused by the puncture, is very closely associated with those just considered. Where the insect inserts its beak the contents of the cells are devoured, and the amount of dead tissue from this cause may amount to a space nearly as large as a pinhead under each insect. A few such spots would not amount to anything, but when a branch is badly attacked it practically involves the whole tissue. The growing part of the branch is only a thin layer just beneath the bark, and the effect of a severe attack is to make this tissue, which should be in an active growing condition, assume a passive, resting state.

This is the condition known commonly as "hide-bound," and gives to the tree a dried-up appearance. It should be said that there are other causes which produce the hide-bound condition as well and perhaps oftener than do scale insects. Injury of this kind only occurs in connection with conditions of arrested growth. When growing actively, the tree early replaces the destroyed tissue by new cells, and the injury is slight. It may be healed, also, by any treatment that will induce growth.

The third class remains to be considered. The excretions of the insect consist of a copious watery material, which, on drying, becomes slightly sticky, and probably contains a very small amount of sugar. It holds the dust firmly, and seems to be a very suitable media for the development of fungi, especially the species known as the "black smut" fungus. The secretion sometimes gums up some of the breathing pores, but this can hardly be counted an injury, as the leaf has a superabundance of these pores, and chiefly situated on the under side of the leaf, where they are safe from this contingency. The dust and the fungi produce injury in two ways: by covering the leaf and forming a screen, through which the action of the sun on the chlorophyl of the leaf, in elaborating food, is diminished; and second, by disfiguring the fruit, making a washing necessary, and entailing both an expense and a decrease in market value.

These injuries are of a most serious nature, and the latter, in the case of citrus fruits, is often far in excess of the amount that a gas treatment (the most expensive method) would cost. In most situations the dust is a very inconspicuous element of the smut, and in such cases the application of a fungicide might be the cheapest and most satisfactory treatment. A thorough washing spray of water, repeated often enough, would keep a tree clean, no matter how badly infested.

It can thus be seen that each kind of injury from the attack of black scale can be reduced to practically nothing by the use of methods which are not calculated to destroy the insect.

DESTRUCTION BY PARASITES, DISEASE, ETC.

This leads us to a consideration of the history of the scale when left to itself. Each well-developed insect lays a large number of eggs. It has been estimated that as high as a thousand are sometimes laid. Let us suppose, however, that five hundred were produced. As there are no males, each one of these that comes to maturity lays five hundred more. It will be evident at once that this rate of increase cannot go on long. Some time there must be a limit reached, a balance established, when not over one egg on an average out of five hundred will produce an insect which will go successfully through its life and deposit its eggs. If there were nothing else to produce this result, the amount of available food would. It is not, however, the want of food that is actually the cause of this condition of diminution in number. With the exception of a few cases of scales having been crowded off a stem by their more vigorous brothers, I know of no case where the available food was not ample to sustain even larger numbers. We all know that absolutely neglected trees, though differing somewhat from year to year, still maintain a general average of scale insects far below their capacity for food supply. On such trees the expectation of life of a young scale is but one to five hundred.

Parasites take some part in the destruction of the black scale. The common native Chalcid is estimated, by Professor Howard, to destroy 75 per cent, but this only means that three out of four of those that came to adult size contained the parasite; that is less than 1 per cent of those hatched. I have never known of a case where more than 2 per cent were destroyed from this cause. The other 98 per cent met some other fate.

The black scale is very subject to disease. The diseases seem to be similar to, if not identical with, those which destroy the chinch bug in the Mississippi Valley. On a tree well infested with black scale, I have seldom met with a death-rate of less than 90 per cent, and, evidently from this cause, occurring between the time the eggs are laid to the time of the second moult.

There is a considerable number that crawl down the trunk, or drop from the tree, and occasionally there is a wholesale destruction due to a hot, dry wind, or some such meteorological condition.

The number ordinarily destroyed by ladybirds is much smaller than is usually supposed. Ladybirds, and their larvæ, are to be met with more abundantly in other situations than in scale-infested trees; indeed, it is the exception to find them particularly abundant on such trees. On the University grounds, in Berkeley, the only case of particular abundance of ladybird larvæ on a tree infested by any kind of scale insects, which has occurred during a period of five years, was a carob tree, infested with the greedy scale, which had for two seasons a great many "twice-stabbed ladybird" larvæ, and which is still scaly. The fact is quite observable that the beetle of the *Rhizobius ventralis* feeds by choice, if not entirely, on the diseased larvæ of the black scale; and it is also true that the whole family are closely allied with, and doubtless derived from, fungus-eating beetles. So it may be that the ladybirds only do well on insects made palatable by the attack of certain bacteria or fungi.

Whatever may or may not be the merits of the ladybirds, the fact remains that the great majority of these insects are destroyed by disease; that is, with the present adjustment of nature, the diseases are, practically, the only things capable of maintaining the present balance. A very slight variation in the degree of virulence of the diseases would entirely change the per cent of scale insects on a tree, or in a section of country. The almost entire destruction of the scale by disease is a matter of not infrequent occurrence.

Wherever spraying is systematically pursued, the per cent of disease is strikingly less. When most of the insects on a tree are destroyed by a wash, it appears that the distribution of the disease is prevented, and the few that survive are healthy, and lay healthy eggs; and thus, the spraying of a tree, and the discontinuance of the treatment, may result in a worse condition than if not sprayed at all. If, after having sprayed once, the policy of not spraying be decided upon, the trees should be carefully watched; all those exhibiting a striking increase in scales should be treated again, and the treatment persisted in till the withholding of the wash shows but little or no immediate effect.

It might appear to be desirable to use the diseases as a means of treatment, and I have do doubt that that could be made a very valuable adjunct; but the experience in Illinois, with the chinch-bug diseases, shows that the conditions under which they will produce the desired results are entirely beyond our control. While the diseases often produce the most satisfactory results, amounting to the extermination of the pest, still at other times the results are nothing.

Another scale insect, the well-known *Icerya*, having been so thoroughly destroyed by the Australian ladybird, *Vedalia cardinalis*, many have believed that an equally effectual remedy could be found for the black scale. Such a search was well worth inaugurating, but the promise of results, as well recognized by entomologists generally, was by no means as good as for such an insect as the *Icerya*. The egg-case of the latter insect presented a particularly vulnerable point of attack. The State very properly made a good appropriation for the purpose, the services of Mr. Koebele were secured, and no effort was spared to make his work a success. There were imported, according to the reports of the State Board of Horticulture, no less than sixty species of predaceous and parasitic insects. Of this number, only one has appeared to at all justify the expectations of those believing in the general efficacy of this means of destroying insect pests. This is the now famous *Rhizobius ventralis*. A few pairs of this insect, about twenty specimens, were received by Mr. Cooper, the President of the State Board of Horticulture, in May, 1892, and placed in his olive orchard, near Santa Barbara. In December of the same year, Mr. Koebele visited this orchard and found the insect doing well, and plentiful in all stages of development. The next year they increased very rapidly, and were reported to have practically stamped out the black scale. During October of that year, four hundred and fifty-three colonies, representing fifteen to twenty thousand insects, were distributed all over the State. The black scale, however, remained fairly abundant on Mr. Cooper's place, for in 1894 a larger number of the *Rhizobius* was said to have been distributed from there; and there is said to be still some black scale in his orchard, though the *Rhizobius* is much less numerous.

There is no doubt that there was a great decrease in the abundance of black scale, associated with a great abundance of the *Rhizobius*, in the case of Mr. Cooper's orchard. This is conceded on all hands. The general question of the effectiveness of the *Rhizobius* is one, however, which has stirred up a greater amount of discussion, and has produced more heated partisan feeling, than has ever been the lot of an insect to occasion before. The importance of the subject is such, that the writer has given it considerable attention, and twice visited and carefully gone over the ground about Santa Barbara, and in other parts of the southern portion of the State. There seems to be no question but that the *Rhizobius* does destroy a certain number of the black scale. The *Rhizobius* has also become thoroughly well acclimated in the region about Santa Barbara, and in a number of other points in the State.

It is a fact that the *Rhizobius* has been present in trees in which there has been a notable decrease in the abundance of the black scale; but it is also true that it has been present in about equal numbers, at the same time, in neighboring trees in which there was no decrease in the black scale. It is incontestably the fact that, in the City of Santa Barbara, where the *Rhizobius* has been allowed to have its own way, and where it has been very abundant for more than a year, there is to-day a larger amount of black scale than at Berkeley, where there has been no spraying for three years, and where the *Rhizobius* has not been able to secure a foothold. The black scale does not do quite as well at Berkeley, perhaps, as at Santa Barbara, but I have seen some trees here that were as badly affected as any I have met with anywhere.

Almost every case investigated, where wonderful results were claimed for the *Rhizobius*, proved that, though the *Rhizobius* may have been present, it could have been only an extremely small factor in the results obtained. There are a few cases where there was an exceptional abundance of the *Rhizobius*, accompanied by a striking decrease of the scale; but there are more cases of an equal decrease in scale without the exceptional abundance of the *Rhizobius*.

Taking all the evidence, it appears that the *Rhizobius* is scarcely, or not at all, more efficacious than the native ladybirds, except, perhaps, being slightly less omnivorous.

Insecticides for the Scale.—The remedies for killing the scale are many. Those recommended by this department are the gas treatment, or the use of one of the standard washes—lime, salt, and sulphur; resin soap, or kerosene emulsion; or, on small trees, the hand-scrubbing method of the florist.

Gas Treatment.—Cover the plant with an oiled tent, and for each 100 cubic feet of contents place in a bowl beneath the tent $\frac{2}{3}$ ounce of water, $\frac{1}{3}$ ounce of sulphuric acid (oil of vitriol), and $\frac{1}{3}$ ounce of potassium cyanide (58 per cent), being careful not to inhale the poisonous gas, nor to allow it to escape from the tent for half an hour. The leaves may be injured if used during the middle of the day.

Washes.—Lime, Salt, and Sulphur Mixture, a *winter* wash for deciduous trees. Take lime 8 pounds, salt 3 pounds, and sulphur 4 pounds, for each 12 gallons of water. Mix one fourth of the water, one fourth of the lime, and all the sulphur, and boil for one and a half hours; put the salt with the rest of the lime, and slake with hot water; add to the above, and boil half an hour longer; add the remainder of the water, and apply as a spray.

Resin Soap: For 100 gallons for *summer* use, or for use on citrus or olive trees, take resin 18 pounds, caustic soda (98 per cent) $3\frac{1}{2}$ pounds, and fish oil $2\frac{1}{2}$ pints; for *winter* use for deciduous trees, resin 30 pounds, caustic soda $6\frac{1}{4}$ pounds, and fish oil $4\frac{1}{2}$ pints. The material is put in a kettle and covered with four or five inches of water. The lid is put on and the mixture boiled two hours or more, and then the rest of the water is added, a little at a time. Spray on the plants.

Kerosene Emulsion: Make a soap solution of half a pound of soap to a gallon of water. Heat it to boiling, and add two gallons of kerosene. Pump it through the spray pump, with good pressure, for five to ten minutes. For use, add ten times as much water as you have of emulsion. Apply as a spray. Sour milk may be used instead of the soap solution. The emulsion is made more effective by the addition of a very small amount of arsenic to the soap solution, or of buhach to the kerosene.

The gas treatment is by far the most expensive, but is thorough and quite extensively used. Of the washes, the resin soap is the cheapest; the lime, salt, and sulphur has value as a fungicide, besides being a good insecticide; and the kerosene emulsion is easiest to make, especially in a small quantity. The scrubbing method is only practical on small trees, but is then quite as cheap as any process. The latter process is best used before the eggs are hatched, while all the others are not satisfactory except after their emergence.

The destruction of the young scale is quite an easy matter, and any good insecticide which kills by contact will accomplish the result. The difficulty is chiefly in the fact that one treatment is all that an average fruit-grower in this State will give. If a treatment be made when most of the eggs are hatched, and another in about a month, the result will be much more satisfactory. The entire destruction of the pest cannot be expected with any ordinary treatment, and I doubt if it is a practical possibility by any method, except on a very few plants or trees; nature, unaided, will often accomplish that.

In dealing with the black scale the first thing to be recognized is the fact that any method, or lack of method, will sometimes result for the best; that no rule can be followed blindly and accomplish what is desired, except by accident. The treating of insects, like any other branch of agriculture, is an art; and to be properly followed requires an intelligent understanding of the principles, and a close observation of the conditions. The particular line of action will then depend upon the judgment of the farmer. One will seldom err in his judgment if he clearly recognizes the state of the case.

In regard to the black scale, it appears that the most important method of defense is along the line of keeping the tree in a condition in which the scale can produce no injury. This requires careful watching of the tree, and a quick appreciation of the evidences of distress; or, rather the anticipation of them, and the command of means for at once remedying the trouble by cultivation, irrigation, or the use of insecticides. The introduction and fostering of predaceous or parasitic insects of all kinds, and of diseases, is very important, but should never be made the pretext for neglecting the trees to their injury, or to the injury of the crop.

There may be parts of the State where natural checks can be depended upon, and spraying or gas never resorted to; and, on the other hand, it is possible that there are others where the only hope of success is to spray without ceasing; but in the greater part of the State neither extreme measure is best.

In all special treatment for the black scale the results to the immediate crop is the only basis upon which to estimate the value of the application or treatment, because the natural checks, under normal conditions, will be able to accomplish as satisfactory results.

THE LECANIUMS OF CALIFORNIA.

By Mary W. Tyrrell.

(Student in the Entomological Laboratory.)

Our largest and most conspicuous scale insects belong to the genus *Lecanium*, and are of great economic importance. Some of the species show such a close resemblance in general appearance, and exhibit so much variation on different food-plants, that it becomes peculiarly difficult to distinguish between them; though the number of species recognized as occurring in California is not large.

Lecaniums injure plants by extracting the sap. A black fungous growth is found in the honey-dew which they deposit upon the plant. This fungus sometimes becomes very thick, and gives the foliage and fruit a very dirty appearance.

The young insects are regularly oval or elliptical, being much longer than broad, and are generally carinate. As they grow older they become convex, and in most species the shape approaches hemispherical; in some, becoming extremely irregular where the insects come in contact with a twig, or with each other. When found on broad, flat surfaces, the shape is more nearly regular; but when crowded together, or on a narrow surface and square stems, they become unsymmetrical, and sometimes elongated.

In most species, the carinæ become less distinct as the insects develop, and in some adults they are almost indistinguishable; but often in the same species the adults may vary from forms with very distinct carina to those with none at all. Young *Lecaniums* are light yellowish in color, developing pigment spots as they grow older. These finally coalesce, and give a uniform color to the body. This varies in the different species

PLATE II.

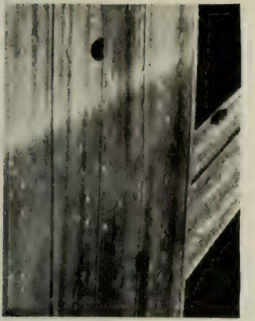


Fig. 1.

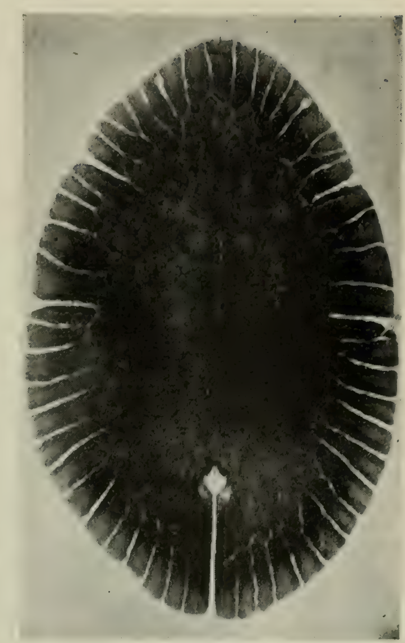


Fig. 2.

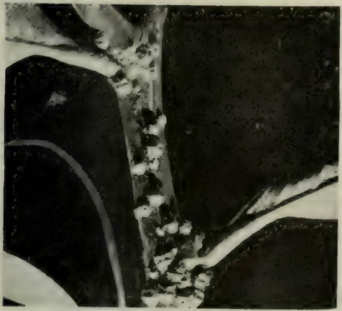


Fig. 4.

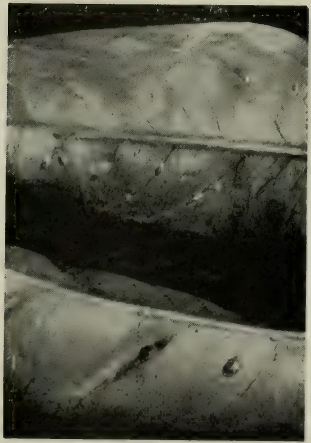


Fig. 3.

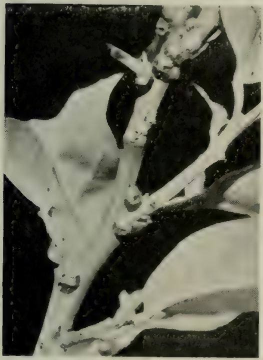


Fig. 5.

FIG. 1. *Lecanium tessellatum*, Signoret, on palm from greenhouse in Oakland. The small, whitish spots are *Mytilaspis* sp.?

FIG. 2. *Lecanium tessellatum*, greatly enlarged.

FIG. 3. *Lecanium hesperidum*, Linnæus, on orange from Berkeley.

FIG. 4. *Lecanium oleæ*, Bernard, on lemon from Berkeley.

FIG. 5. *Lecanium oleæ*, Bernard, on orange from Berkeley.

from light brown, through dark brown, to almost black. Much variation of color sometimes occurs in the same species.

In most cases the hair cells of the dorsum of the young become modified as the insects develop, forming pits, which are irregularly distributed over the body. In *Lecanium pruinosum* and *L. insignicola*, they are but little modified. In *L. hesperidum*, faint radiating lines occur, which give the simple pits a crater-like appearance. A further modification of the pit structure is found in *L. hemisphæricum*, where the pits are much larger and cover about one twentieth the area of the skin. In *L. oleæ* they are still larger, covering nearly one fourth the area of the skin, and each pit is inclosed by a polygonal figure. The pits in *L. tessellatum* are small and not much modified; but their arrangement has become conformable, in this species, to the areas into which the skin is divided.

Adult females vary in size, from one eighth to three eighths of an inch, being generally distinctly longer than broad. Most species lay eggs, which accumulate under the body; the latter becoming more and more convex. Shortly after the larvæ appear, they crawl out from beneath the body of the mother and scatter over the leaves and twigs of the plants. After moulting, they become less active; the adults of most species are absolutely fixed upon the plant.

The young of two species are produced alive.

The antennæ of the adult females have the first two joints comparatively short, and subequal in length; a terminal joint, which is irregularly notched; and either four or five intermediate joints, which vary in size in the different species.

The margins of the body of the young show the separation into head, thorax, and abdomen. This division becomes less evident as the insect develops, quite disappearing in most species. The hind section of the alimentary canal is furnished with a ring, which has six, or occasionally eight, very long, coarse hairs, which reach nearly to the anal opening, and which can be exerted so as to project far out of the body, when the hairs spread radially.

The males of the two species known to us, are about one eighth of an inch long, exclusive of the style, and half as broad. The body is light brown. The antennæ are ten-jointed; joints one and two are comparatively short, and subequal; joint three is longer, narrow at the base, and gradually widening; joint four is longest; joints five, six, seven, and eight are a little shorter, and subequal; joints nine and ten are still shorter, and subequal. All the joints of the flagellum are bordered with hairs, those bordering the terminal joint being knobbed. The head is furnished with two purplish dorsal eyes, two larger, darker, ventral eyes near the base of the head, and two ocelli, which are anterior and lateral to the ventral eyes. The mouth parts are obsolete.

The thorax is longer than the abdomen. The prothorax is about as wide as the præscutum of the mesothorax, which is darker colored than the scutum, but about equal to it in length. The anterior margin of the præscutum of the mesothorax is convex, while the posterior margin is horizontal. The scutellum of this region is darker colored than the postscutellum, and about one fourth as long. The postscutellum is rounded at the posterior end, and almost conceals the small metathorax.

The two transparent anterior wings are about one eighth of an inch long, and about one sixteenth of an inch wide. The venation is simple, only the subcostal and median veins being present. The rudimentary posterior wings are hooked to the anterior wings.

The tibiæ are long, slender, and bordered with hairs. The tarsi are either one or two jointed, and about one fourth as long as the tibiæ.

Our common species may be determined by the following synopses:

I. General Appearance.

- Surface of dorsum distinctly reticulated. *L. tessellatum.*
- Surface of dorsum not distinctly reticulated.
  - Dorsum flattened between transverse carinæ. *L. oleæ.*
  - Dorsum covex on top.
    - A medium dorsal row of light spots. *L. hemisphæricum.*
    - No light spots on the dorsum.
      - Body soft, abdominal cleft normal. *L. hesperidum.*
      - Body firm, abdominal cleft conspicuous.
        - Dorsum normal, lobes spreading. *L. pruinosum.*
        - Dorsum inflexed. *L. insignicola.*

II. Skin Structure.

- Most of the pits bordering the reticulations of the skin. *L. tessellatum.*
- Pits uniformly distributed over the skin.
  - A polygonal area surrounding each pit. *L. oleæ.*
  - No polygonal area surrounding the pits.
    - Pits occupying about one twentieth of the surface of the dorsum. *L. hemisphæricum.*
    - Pits occupying less than one fiftieth of the skin surface.
      - Pits crater-like, feebly connected by radiating lines. *L. hesperidum.*
      - Pits simple.
        - Pits occupying about one eightieth of the skin surface. *L. pruinosum.*
        - Pits occupying about one hundredth of the surface of the dorsum. *L. insignicola.*

LECANIUM TESSELLATUM—(*Signoret*).

[Plate II, Figs. 1 and 2.]

Lecanium tessellatum, Signoret, Bull. Soc. Ent. Fr. (5), III, p. 401.
Cockerell, Canadian Entomologist, XXVII, p. 257. (*L. perforatum*, Newstead.)
Craw, Report California State Board Horticulture, 1894, p. 92. (*L. depressum*, Targ.-Toz.)

Body chestnut brown, lighter along the margin; oval, about two thirds as broad as long; flattened or very slightly convex, rather acute at anterior end; often unsymmetrically flattened on one side, due to its position on the plant. The surface of the dorsum is very distinctly reticulated, the carinæ forming raised polygonal figures. Under the microscope (Plate II, Fig. 2), after treatment with caustic potash, the skin is seen to be covered with irregular quadrilateral and pentalateral figures, which are bounded by transparent lines. These figures become longer and narrower as they reach the edge of the body, and the transparent lines bounding them become more distinct. The pits in this species are small, and are inclosed by the polygonal areas; most of them being conformable to the lines bounding these areas.

The antennæ are eight-jointed. Joints one and two are comparatively short, and subequal; joints three and four are longer, and subequal; joints five and six are shorter than three and four; joint seven is a little shorter than five or six; joint eight is much longer, narrow, and has three notches on each side. The anal opening is bounded by six hairs.

This species produces living young, and inhabits greenhouses principally, being found on various palms. It resembles *L. hesperidum*, which, in an early stage, shows reticulations in its dorsum very similar

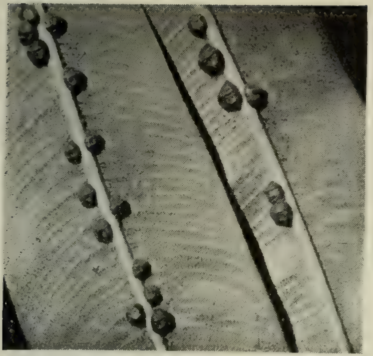


Fig. 1.

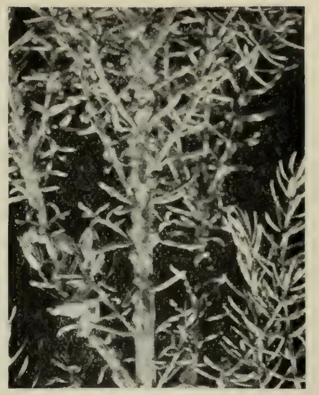


Fig. 2.

Fig. 3.

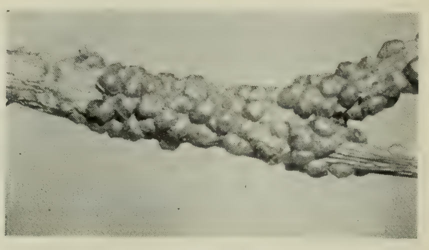


Fig. 4.

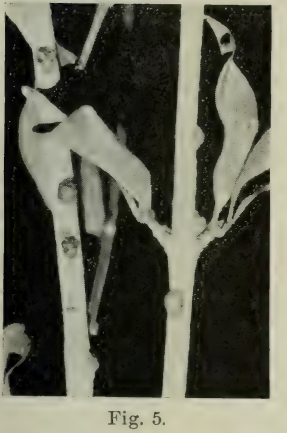


Fig. 5.

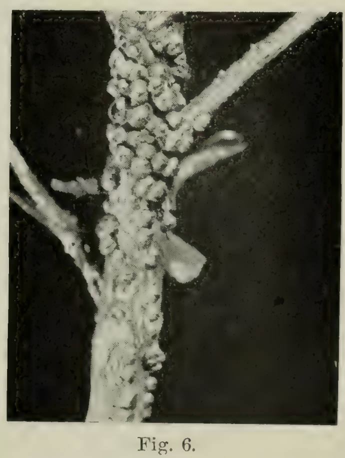


Fig. 6.

Fig. 1. *Lecanium oleæ*, Bernard, on oleander from Oakland.
Fig. 2. *Lecanium oleæ*, Bernard, on heather from Berkeley.
Fig. 3. *Lecanium oleæ*, Bernard, on apricot from Berkeley.
Fig. 4. *Lecanium oleæ*, Bernard, on pelargonium from Oakland.
Fig. 5. *Lecanium oleæ*, Bernard, on pittosporum from Berkeley.
Fig. 6. *Lecanium oleæ*, Bernard, on baccharis from Berkeley.

to those found in this species. The reticulations, however, are not continued in the adults, in *L. hesperidum*, as they are in *L. tessellatum*. The two species can be further distinguished by the shape, color, and skin-structure.

The adult *L. tessellatum* is oval, flattened, chestnut-brown in color; the body is hard, and most of the pits of the skin are conformable to the reticulations; while *L. hesperidum* is generally elliptical in outline, slightly convex, reddish or yellowish-brown in color; the body is soft, and the skin-structure shows no reticulations, though the pits are feebly connected by faint, radiating lines.

LECANIUM OLEÆ—(*Bernard*).

[Plate II, Figs. 4, 5; Plate III, Figs. 1, 2, 3, 4, 5, 6; Plate IV, Fig. 1.]

Lecanium oleæ, Bernard, Mem. d' Hist., Nat. Acad., 1872, p. 108.
Comstock, Report U. S. Dept. Agr., 1880, p. 336.
Cockerell, Bull. Bot. Dept. Jamaica, Vol. I, p. 72.
Cockerell, Insect Life, Vol. III, 1891, p. 103.

Adults generally have one longitudinal and two transverse carinæ, which are always obtuse. Short, obtuse, transverse carinæ extend along the edge of the dorsum, which is quite distinctly roughened. The longitudinal carina is sometimes indistinct between the transverse carinæ.

The color varies from light brown, through dark brown, to almost black. The shape approaches hemispherical; the dorsum is flattened between the transverse carinæ, and its highest portion is on the anterior carina. The margin of the dorsum is nearly perpendicular.

Under the microscope, after treatment with caustic potash, the skin is seen to be covered with irregular polygonal figures, each one containing a circular or elliptical pit. These pits are irregular in distribution, but occupy about one fourth the area of the skin surface.

The antennæ are generally seven-jointed. Joints one and two are short, and subequal; joint three is longer; joints four and five are shorter than joints three and four, and subequal; joint seven is longer, narrow, and notched. Specimens are found occasionally with eight-jointed antennæ, having two short, subequal joints before the terminal joint. The anal opening is bounded by six hairs.

Lecanium oleæ has a great variety of food-plants. The specimens studied were found on orange (Pl. II, Fig. 5), lemon (Pl. II, Fig. 4), apricot (Pl. III, Fig. 3), peach, olive, oleander (Pl. III, Fig. 1), myrtle, pittosporum (Pl. III, Fig. 5), pelargonium (Pl. III, Fig. 4), abutilon, baccharis (Pl. III, Fig. 6), pomegranate, heather (Pl. IV, Fig. 2), and barberry (Pl. V, Fig. 1).

Lecanium oleæ varies greatly on different food-plants; indeed, no other one of our common species is so different in this respect. The color on some plants is light brown; on others, dark brown; on still others, almost black, and occasionally specimens almost white have been found. Its size, shape, and markings are as various as its color. The carinæ are sometimes entirely absent; and light-colored specimens might be mistaken for *L. hemisphæricum*, or for *L. pruinosum*. It can be distinguished from the former, as follows: The carinæ, when present in *L. hemisphæricum*, are acute, but obtuse in *L. oleæ*. The dorsum of *L. oleæ* is flattened between the transverse carinæ; but *L. hemisphæricum* is very convex in the middle. A median dorsal-row of light spots is present in *L. hemisphæricum*, but never in *L. oleæ*. The surface of *L. hemisphæricum* is smooth and shining, while the surface of *L. oleæ* is dark and roughened. The margin of *L. hemisphæricum* is distinctly flattened, while the margin of *L. oleæ* is almost perpendicular. The skin of *L. hemisphæricum* is covered with pits which are not surrounded by contiguous polygonal figures, as they are in *L. oleæ*. *Lecanium pruinosum* might, sometimes, be mistaken for *Lecanium oleæ*, but can be distinguished from it by the undulate surface, the very convex dorsum, and by the skin-structure.

The male of this species is unknown to me, but has been studied by Mr. B. W. Griffith, of Los Angeles, Cal., who has described it in the Report of the California State Board of Horticulture for 1894, on page 94. His description reads: "Pupa dark gray, varying in length from 1 to 1.5 millimeters; width, from .5 to .8 millimeters. Dorsum with a distinct longitudinal carina and two delicate transverse carinæ.

"Winged male.—Orange-colored, with lighter colored wings. Length of body, exclusive of style, 1.2 millimeters; style, .4 millimeters; anal plates, .5 millimeters. Antennæ, ten-jointed; the first three joints are short; the second is swollen, and pyriform; the fourth is longest, and equal to the first three; the balance of the joints gradually diminish in size; entire length of antennæ, .55 millimeters; wings, 1.1 millimeters; legs slender, and about .8 millimeters in length. Eyes, six in number—two anterior compound, two ocelli at sides of head, and two compound eyes at posterior part of head."

LECANIUM HEMISPHÆRICUM—(*Targioni-Tozzetti*).

[Plate V, Fig. 2.]

Lecanium hemisphæricum, Targioni-Tozzetti, Stud. sul. Coccin., 27.
Comstock, Report U. S. Dep't. Agr., 1880, p. 334.
Cockerell, Insect Life, 1891, Vol. III, p. 103.
Craw, Report Cal. State Board Hort., 1890, p. 102.

The shape approaches hemispherical, often becoming elongated when on narrow surfaces, and when crowded together. The smooth and shining dorsum is a little longer than broad, very convex, acute in front, but rounded posteriorly.

The carinæ, when present, are acute; but the transverse carinæ are often obscure or wanting, while the longitudinal carina is often distinct only at the ends of the body, and is covered with a row of light spots.

The color is light brown, lighter along the margin, which is quite distinctly flattened.

Under the microscope, after treatment with caustic potash, the skin is seen to be covered with irregularly shaped pits, oval, elliptical, and circular. The interspaces are about equal to the diameters of the pits.

The antennæ are eight-jointed. Joints one and two are short, and subequal; joint three is longer; joints four and five are shorter than three, and subequal; joints six and seven are shorter than five and six, and subequal; joint eight is longer, narrow, and notched. The anal ring in this species is bounded by eight hairs.

L. hemisphæricum is found principally in greenhouses, on various palms and tropical plants. Like *L. oleæ*, it often becomes elongated and unsymmetrical, and the carinæ are often obscure or wanting. It can be distinguished from *L. oleæ* by its very convex dorsum, its flattened

PLATE IV.

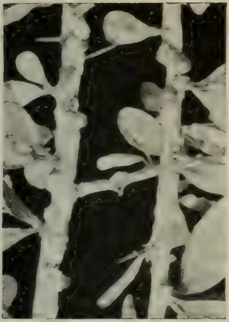


Fig. 1.

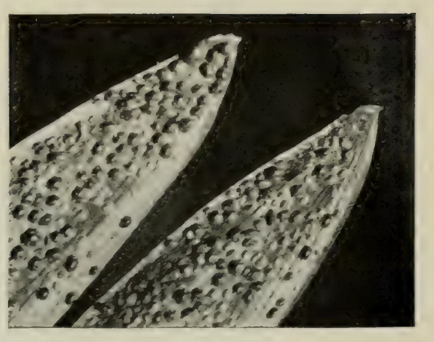


Fig. 2.

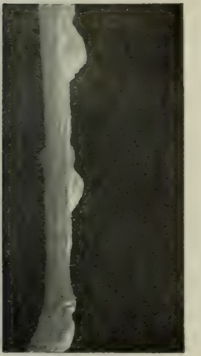


Fig. 3.

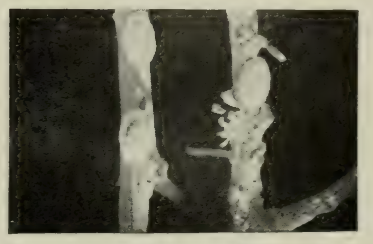


Fig. 4.

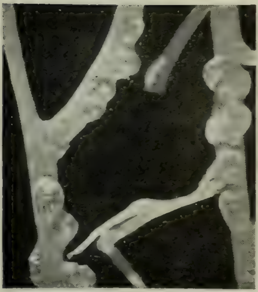


Fig. 5.

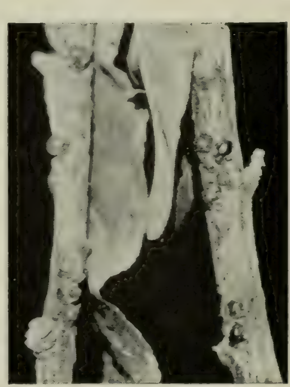


Fig. 6.

FIG. 1. *Lecanium oleæ*, Bernard, on barberry from Berkeley.
FIG. 2. *Lecanium hemisphæricum*, Targioni-Tozzetti, on palm from greenhouse in Oakland.
FIG. 3. *Lecanium pruinosum*, Coquillett, var. *pruinosum*, on locust from Berkeley.
FIG. 4. *Lecanium pruinosum*, Coquillett, var. *pruinosum*, on walnut from Los Angeles.
FIG. 5. *Lecanium pruinosum*, Coquillett, var. *kermoides*, on oak from Berkeley.
FIG. 6. *Lecanium pruinosum*, Coquillett, var. *armeniacum*, Craw, on peach from Oakland.

margin, acute carinæ, smooth surface, its median dorsal row of light spots, and, finally, by the structure of its skin.

LECANIUM HESPERIDUM—(*Linnæus*).

[Plate II, Fig. 3.]

Lecanium hesperidum, Linnæus, Syst. Nat., 1735, II, 739; 1, Faun. Suec., 1746, 1015.
Comstock, Report U. S. Dept. Agr., 1880, p. 335.
Cockerell, Insect Life, Vol. III, 1891, p. 103.
Craw, Report Cal. State Board Hort., 1890, p. 193.
Cooke, Insects Injurious to Fruit and Fruit Trees, 1881, p. 36.

Body soft, reddish or yellowish brown; slightly convex, elliptical or oval in outline; about one third as wide as long. No distinct longitudinal carina, but with many short, indistinct transverse carinæ extending along the edge of the dorsum.

The dorsum of the young of this species shows reticulations very similar to those found in the adults of *L. tessellatum*, but the modification is not carried to such an extent in this species, the reticulations not being present in adults.

Under the microscope, after treatment with caustic potash, the skin is seen to be covered with pits very irregular in size and distribution, but occupying about one hundredth of the surface of the skin. Feeble radiating lines connect the pits, giving them a crater-like appearance.

The antennæ are seven-jointed. Joints one and two are comparatively short, and subequal; joints three and four are longer, and subequal; joints five and six are shorter than three and four, and subequal; joint seven is longer, narrow, and notched.

The anal opening is bounded by six hairs. The young are produced alive.

This species is found on lemon, orange, apricot, and ivy. It bears a slight resemblance to *L. tessellatum*, but can be distinguished from it by its convexity, color, soft body, and, finally, by the structure of the skin.

LECANIUM PRUINOSUM—(*Coquillett*).

[Plate IV, Figs. 3, 4, 5, 6; Plate V, Figs. 1, 3.]

Lecanium pruinosum, Coquillett, Insect Life, 1891, Vol. III, p. 382.
Cockerell, Canadian Entomologist, Vol. XXVII, p. 255.
Craw, Report Cal. State Board Hort., 1892, p. 197. (*L. armeniacum*, Craw.)

The body of the females is convex; the edges of the dorsum sometimes spreading and sometimes vertical. The shape approaches hemispherical, except when the insects are crowded together, when they become extremely irregular. The abdominal cleft is generally conspicuous. The median carina is sometimes distinct, but often only at the ends of the body. The surface of the dorsum is undulated and very irregular.

The color is reddish-brown. Under the microscope the skin is seen to be covered with small circular pits, not abundant, but irregularly distributed over the body; the distance between them averaging from twelve to fifteen times their diameter.

The antennæ are seven-jointed. Joints one and two are comparatively short, and subequal; joints three and four are longer, and subequal; joints five and six are shorter than three and four, and subequal; joint seven is longer, narrow, and notched. The anal ring is furnished with six hairs.

Specimens studied were found on oak (Pl. V, Fig. 3), cherry, locust (Pl. IV, Fig. 3, and Pl. V, Fig. 1), peach (Pl. IV, Fig. 6), apricot, quince, and apple.

This species is what is commonly known as the brown or red apricot scale. It is sometimes covered with a large amount of waxy material, which gives it a pruinose, or frosted, appearance, and which no doubt suggested the name *L. pruinosum*. The pruinose appearance, however, does not indicate a specific difference. Specimens found on locust, peach, and apricot, from Berkeley, were not at all frosted; while specimens received on locust, from the State of Washington, were decidedly pruinose. Mr. Coquillett reports the species as pruinose in the region around Los Angeles. The pruinose appearance is not a strong nor important character in this species. All *Lecaniums* secrete more or less wax, and the conditions, climatic or otherwise, might be such that any species might secrete sufficient wax to give it a frosted or pruinose appearance.

L. oleæ is often so much frosted in Southern California as to be confounded with *L. pruinosum*, which can be distinguished by the absence of transverse carinæ, and by its uniformly convex dorsum; *L. oleæ* being flattened on top. The abdominal cleft in *L. pruinosum* is generally conspicuous, while it is normal in *L. oleæ*. Finally, the skin-structure is distinct in these two species. The pits in *L. pruinosum* are small and but little modified; while in *L. oleæ* they are large and are inclosed by polygonal figures.

L. pruinosum is doubtless an old European species, but the above name is retained until the synonymy is cleared up. Mr. Slingerland, of Cornell University, has recently issued a bulletin entitled "A Plum Scale in Western New York." Specimens of this scale received from Mr. Slingerland, upon plum and maple, prove to be identical, in microscopical structure, with *L. pruinosum*.

We have three distinct varieties: *pruinosum*, *armeniacum*, and *kermoides*, which are all, however, identical in microscopical structure.

The species described by Mr. Craw, in the report of the California State Board of Horticulture for 1891, as *L. armeniacum*, is undoubtedly a variety of *L. pruinosum*, Coq., but the description of the antennæ must have been made from an abnormal specimen. It reads as follows: "Antennæ tapering to the point, seven-jointed; joints one and three subequal; joint two nearly three times as long as joint one; joint four slightly shorter than joints five or six; joint seven is nearly the same length as joint three, and tapers to a point; a few bristles upon the tips and at each joint." The condition almost invariably found is: Joints one and two short, and subequal; joints three and four longer than one and two, and subequal; joints five and six shortest, and subequal; joint seven about equal to joint three, narrow, and notched.

Var. *pruinosum* (Pl. IV, Figs. 3 and 4) is more elongate and more deeply undulated than either of the other two varieties. It retains its pruinose appearance throughout its life; in the adult stage being thickly covered with a waxy secretion, which obscures the ground color, but which can easily be rubbed off. This variety can be further distinguished by the conspicuous abdominal cleft, and by the distinctness of the obtuse longitudinal carina, which extends the entire length of the

PLATE V.

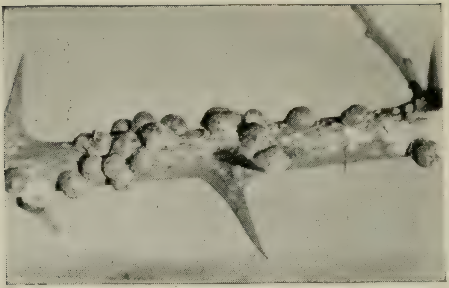


Fig. 1.

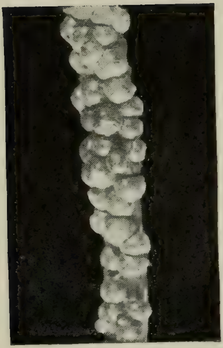


Fig. 2.

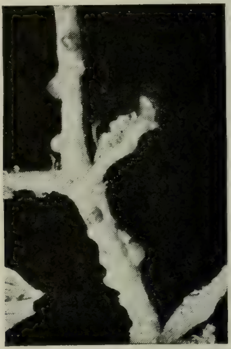


Fig. 3.

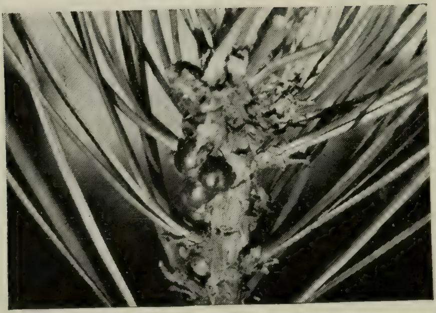


Fig. 4.

FIG. 1. *Lecanium pruinosum*, Coquillett, var. *kermoides*, on locust from Berkeley.
FIG. 2. *Lecanium insignicola*, Craw, on cherry from Temescal.
FIG. 3. *Lecanium pruinosum*, var. *kermoides*, on oak from Berkeley.
FIG. 4. *Lecanium insignicola*, Craw, on pine from Berkeley.

body, and is darker colored than the rest of the body. We have found this variety on locust and walnut.

Var. *armeniacum*, Craw, the true brown apricot scale, can be distinguished from var. *pruinosum*, Coq., and from var. *kermoides*, by its color, which is a rich, polished, mahogany-brown. Both var. *pruinosum*, Coq., and var. *armeniacum*, Craw, are darker colored. Var. *armeniacum* is pruinose in larvæ only, and the longitudinal carina is often indistinct; sometimes perceptible only at the ends of the dorsum, which is not deeply undulated, though the undulations in this variety are more regular than in the other two varieties. Specimens studied were on peach (Pl. IV, Fig. 6), cherry, and apricot.

Var. *kermoides*, found on orange, oak (Pl. V, Fig. 3), and locust (Pl. V, Fig. 1), is smaller, more convex, and more nearly spherical, than var. *pruinosum*. It is generally much smaller on oak; but on locust and orange it is larger. The longitudinal carina is indistinct, often entirely absent; while the dorsum is less deeply undulated, and not always pruinose in the adult. In the region around Berkeley, the larvæ are covered with a thick waxy secretion, and the adults are very slightly, or not at all, pruinose. But specimens received from the State of Washington were very thickly pruinose.

Male of var. Kermoides.—Body light brown. Scutellum of the mesothorax oblong, about one fourth as wide as long, and about one fifth as long as the postscutellum. Anterior and posterior margins of the scutellum very nearly parallel; lateral margins slightly concave. The tibial spur is small or obsolete. The tarsi are very nearly one fourth as long as the tibiæ. They are almost as wide near the tip as elsewhere; not distinctly jointed, and the ungues coalesce at the tip of the tarsus.

Specimens studied were taken from oak.

In the Report of the United States Department of Agriculture, 1888, Professor Comstock has figured on Plate IX as *kermes* on oak, which bears a very close resemblance to the variety *kermoides* on oak, and is probably the same thing.

LECANIUM INSIGNICOLA—(*Craw*).

[Plate V, Figs. 2, 4.]

Craw, Report of Cal. State Board Hort., 1894, p. 92.
Cockerell, Canadian Entomologist, Vol. XXVII, p. 255.

The dorsum of the female is very convex, and very much inflexed, almost entirely concealing the sternum. The inflexed portion of the dorsum rests upon the twig. The rounding of the dorsum makes the species appear almost spherical as it rests upon the twig, but when it is removed it is seen to be irregular and unsymmetrical. The general shape, however, is spherical, becoming extremely irregular where crowded together and at the point of attachment.

The abdominal cleft is very conspicuous. The anal ring is bounded by six hairs. The surface of the dorsum is smooth, but covered with minute dark spots. There is no indication of carinæ, either longitudinal or transverse. The color is dark brown, or black, sometimes reddish underneath.

Under the microscope, after treatment with caustic potash, the skin is seen to be covered with small pits, which are very little modified; and the structure of the skin is very similar to that of *L. pruinosum*.

The antennæ are seven-jointed. Joints one and two are short, and subequal; joints three and four are longer, and subequal; joints five and six are shorter, and subequal; joint seven is longer, narrow, and notched.

This is the only one of our common species that shows no trace of carinæ, or markings of any kind. The general appearance of this insect is strikingly different from any other *Lecanium;* but the structure of the skin and the antennæ show it to be closely related to *L. pruinosum.* The antennæ in the two species are almost identical, and the skin-structure differs only in the relative abundance of the pits.

The young crawl about the pine needles, but the adults are found at the base of leaf clusters on the twigs, at the ends of branches.

The males of this species are darker-colored, larger, and more robust than those of *L. pruinosum*, from which they can be distinguished by the size and shape of the scutellum of the mesothorax, and by the structure of the legs. The scutellum in this species is a little more than one fifth, nearly one fourth, of the postscutellum, and its anterior margin is concave, while the posterior margin is nearly straight. *L. pruinosum* has a more narrow scutum, with nearly parallel transverse margins.

The tibial spurs of *L. insignicola* are large and conspicuous; the tarsi, which are indistinctly two-jointed, are not as wide at the tip as elsewhere, and the ungues are conspicuous. The tarsi of *L. pruinosum* are distinctly one-jointed; the tibial spurs are inconspicuous, and the ungues are fused with the tarsus.

Specimens studied were from pine (Pl. V, Fig. 1), and cherry (Pl. V, Fig. 2).

III.

MISCELLANEOUS.

Preparation of Fruit Specimens for Exhibitions.
The Russian Thistle in California.
Timber-Physics in California.

MISCELLANEOUS.

PREPARATION OF FRUIT SPECIMENS FOR EXHIBITIONS.

By E. W. Hilgard.

The conservation of fruit samples for permanent exhibitions, that are, therefore, to remain in good condition for over a year, necessarily involves more care and precautions than need be employed for exhibits that are to serve simply for one Fair season. Nor is it possible to give one sweeping formula that will serve equally well for all fruits, without any brain-work on the part of the operator. This should be distinctly understood from the outset; and it involves, not merely the following out of a set rule, but also the exercise of some discretion and skill on the part of the exhibitor.

In the first place, the fruit should be properly selected; neither too unripe to show its distinctive features, nor so ripe as to be readily bruised in transportation. The rule should be to take the fruit *as unripe as is consistent with a proper exhibition of the size, surface texture, and color.* The greatest care should be taken that in gathering and handling (the latter restricted as much as possible) not the least bruise is inflicted. It is best not to touch the fruit with the hand at all, but to handle it in a piece of tissue paper, such as is used for wrapping fruit. This can be done by holding the paper close under the chosen specimen and cutting the stem with a pair of shears, avoiding any jar or pressure. Immediately before placing it in the preservative fluid it should be thoroughly rinsed in a jet of clean water, so as to remove all dust and fungous germs as much as possible.

Density of the Fluid.—The *preservative fluid* must not only preserve the fruit from decay, but also from shrinkage or bursting. The latter two conditions can, for the purpose now in view, only be fulfilled by ascertaining the density of the fruit juice by means of a "must spindle," such as is familiar to all wine-makers, and can be found in any winery. The operator must then give the preservative fluid the same density as that of the juice. I have heretofore attempted to give a rule by which this density can be approximately estimated; but for any long conservation no approximation short of that which can be attained by the use of an ordinary spindle will serve the purpose, except, perhaps, in the case of citrus fruits, whose thick rind prevents, to a considerable extent, the shrinkage or bursting that is almost certain to befall all other fruits, unless the condition of "equal density" of the juice inside, and the preservative fluid outside, be fulfilled. The condemnation, by the users, of some of the best preservative agents, has resulted from a failure to attend to this point.

The juice of fruit as unripe as that which should be used in this case will rarely have a greater density than *six degrees of the must spindle.*

Those who are absolutely unable to obtain the use of such a spindle, may, at a guess, be successful by making *that* the density of their fluid, according to the rule given below. It will then at least not burst the fruit, although it may shrink it a little. If the juice cannot readily be pressed for the test, it can be got out by stewing the fruit, as in jelly-making, in a jar covered so as to completely prevent evaporation.

The best substance for the purpose of *increasing the density* of the fluid to the proper point is *glycerine*, which can now be obtained, in commerce, cheaply enough. Pure refined sugar, made into clear syrup, may be substituted, but is much more apt to darken the color of the fluid and fruit.

As to the *proportions* to be used: Since a gallon of water weighs 128 ounces, *one* per cent of that (or each degree of the must spindle) will be, in round numbers, 1¼ ounces, to be added to a gallon of preservative fluid for each degree shown by the spindle in the fruit juice. For example, if the spindle shows 4 degrees, then 6 ounces of sugar, or good commercial glycerine, must be added for each gallon of preservative fluid wanted. The glycerine can be apportioned by *measure*, instead of by weight, by taking *in place of each ounce by weight* that would be required, *four fifths* of an ounce in druggists' "*fluid ounces.*"

Preservative Agents.—As to the preservative agent to be used, it is true that the most powerful antiseptic ordinarily available is "corrosive sublimate," now much employed in sanitary disinfection; but it is also such a powerful poison that it seems unsafe to place it in the hands of those who ordinarily will put up the fruit samples. Moreover, unless extraordinary precautions be used, it gives the fruit a dingy, ghastly aspect, arising from a whitish film of calomel that gathers on the surface. At the same time, it is the most certain of all means known to preserve fully the *form* of the fruit. If used, it requires only four parts in a thousand, or about half an ounce per gallon, to effect complete preservation. Distilled water must be used for the solution, and only a competent druggist should make it up, and carefully label it "poison," as should also be done with all fruit thus preserved. This fluid is especially well adapted to the preservation of figs.

Common salt necessarily shrinks all fruits preserved in it and darkens their colors. *Alum*, frequently recommended, is not a good preservative, because, besides shrinking the fruit, it dissolves the colors very effectively, and also changes them.

The most available preservatives, because accessible to all and not dangerous, while very effective, are *salicylic* and *sulphurous acids*—the former now readily obtained from all druggists; the latter generated from burning sulphur, as is done in bleaching fruit—the latter fact emphasizes the difficulty encountered in using sulphurous acid as a preservative for fruit samples. It inevitably bleaches the colors in the course of time, if employed of such strength as to be an effectual preservative. Nevertheless, the ease with which it can be used, and the certainty with which it acts, have made it a favorite for citrus fruits, apples, and other fruits not having very delicate colors. But cherries, plums, and berries of all kinds assume a bright yellowish or almost white tint when so preserved for a length of time.

The solution is most readily prepared in the following manner: Fill a clean keg or barrel half full of clean, clear water, bunghole up, and introduce a cellarman's "sulphur strip" (cotton stuff passed through melted sulphur), leaving it to burn as long as it will, while closing the hole with the hand or mop. When the strip goes out, withdraw it, close the bunghole, and give the cask rolling shakes until, within a minute, the gas is all absorbed. Then blow in fresh air with a bellows, and repeat the burning of sulphur strip ten or twelve times; this takes about an hour's time. Then keep the barrel well bunged up until the fruit is to be put up, when the proper amount of glycerine can be added to each jar of different fruit, or to the whole if no difference is to be made.

Or, according to the method used at the rooms of the State Board of Trade, at San Francisco, an iron pan is floated on the water in a (40-gallon) barrel open at one end and three quarters full. Then sulphur is burnt in the pan, two or three tablespoonfuls at a time, and the water well stirred each time, until about two pounds of sulphur has been consumed. The barrel-head is of course laid on while the sulphur burns. The fluid thus obtained is of about the same strength (.1 per cent) as that obtained by twelve burnings of sulphur strip in a barrel half full.

Instead of the gas, the solid "bi-sulphite of soda," which can be had of most druggists, may be used. The acid of the fruit soon liberates the sulphurous acid to a sufficient extent for preservative purposes, as has been shown by the use of the same substance under the name of "California fruit salt." Half an ounce of this compound per gallon of fluid is probably ample for the preservation of fruit not too ripe for the purposes of exhibition, and the bleaching effects are not nearly as great as when the gas is used.

Salicylic acid exerts no bleaching action, and is a very energetic preservative, even at the moderate rate of one fifth of an ounce to the gallon of water, or one ounce to five gallons; the dissolution of the acid is best effected in boiling water. But for the purpose of long conservation, it is best to increase its solubility by using one and one-half ounces to every five gallons, dissolving the extra half ounce by the cautious addition to the (boiling) water of enough sal soda to make it clear, and to make it remain so after cooling. It is of the greatest importance that not a particle more sal soda be used than is just sufficient to dissolve the last flake of the acid; the least excess of soda will tend to soften the fruit and spoil its color.

The solution, so prepared, may be preserved indefinitely, and the glycerine (or white sugar, if glycerine cannot be had) can be added to the extent that may be indicated by the spindle in the fruit juice.

While salicylic acid does not affect the color of fruit as to *tint*, the solution, nevertheless, gradually extracts the color of cherries and berries, coloring the fluid. Thus at least a measure of the original color remains; while nothing is left in the fruit preserved with sulphurous acid, after a few months. Salicylated fruit also preserves, in a measure, its taste, while the other does not.

It is absolutely essential that the jars containing the fruit be hermetically sealed. Glass-stoppered jars can be made tight with "canning wax" or paraffine. A very good way to prevent mould on the surface of the fluid, in case a little air should get in, is to put a few drops of best white coal oil on the surface before sealing.

Since writing the preceding remarks on the subject of preservative solutions, some experiments, then inaugurated, have been subjected to the test of time, and some points of practical value can be added.

First, as regards the use of *salicylic acid*, we find that no solution of either the free acid or the sodium compound stands the test of years of exposure to the atmospheric air in contact with fruit, and therefore mingled with its juices, without being invaded by mould, which ultimately destroys the sample. This can best be prevented by covering the surface of the fluid with not less than one eighth of an inch of white coal oil, and then sealing the jar tightly.

As regards the preservative solution of *corrosive sublimate*, it seems impossible to prevent the precipitation of calomel on the surface of the fruit, imparting to it a whitish, ghastly appearance, whatever may have been its natural color; at the same time diminishing the strength and preservative qualities of the solution. But since the latter are manifestly derived in the main from the presence of the mercury, it occurred to me that the same qualities might be found in a solution of *mercuric iodid* in *potassium iodid*, of corresponding strength, in which case the formation of any insoluble precipitate on the surface of the fruit would be impossible. Such a solution can be made either by dissolving 2.1 ounces of solid mercuric iodid, such as can be purchased of druggists, in a solution of 1.4 ounces of potassium iodid in one half pint of water, the proportion being 4.5 parts of the former to 6.7 parts of the latter, to be afterwards diluted to one gallon. Or, more conveniently, the solution may be made by dissolving 0.53 ounce corrosive sublimate (mercuric bi-chlorid) in one pint of water, also 1.4 ounces of commercial potassium iodid in one pint of water; then pouring the mercuric solution into the iodid solution while stirring violently, allowing the precipitate to dissolve each time before a new addition is made.* The solution is then diluted to one gallon with distilled water; the fluid so formed has a faint yellowish tint; for most fruits, except grapes, it can be used safely by adding to it 7 per cent, or about 10 ounces by weight, of commercial glycerine per gallon.

Before pouring it over the fruit it should be allowed to stand for several days, to make sure that it does not deposit any red sediment of mercuric iodid. If this should happen, the solution should be poured off from the sediment, and a few grains of potassium iodid added to prevent its recurrence.

For a few weeks or months this solution does not change the color of the fruits materially; but afterwards the fruit becomes more or less bleached, while preserving a perfectly clean surface. After a year or more the solution assumes a brownish tint (as also happens with corrosive sublimate solution), and should then be renewed.

It is possible that a solution somewhat weaker in the mercuric salt may prove effective as a preservative; but experience has proved that three fourths of the amount prescribed above is not thoroughly effective.

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* This method of preparing the preservative solution was published in 1894 by the State Chemist of Georgia, in Atlanta, without mention of my name as the originator of the mercuro-potassic iodid preservative solution; alleging as the reason that in my private communication to him I had mentioned only the first method of preparation. Every chemist understands that any soluble salt of mercury may be similarly used. (E. W. H.)

THE RUSSIAN THISTLE IN CALIFORNIA.

By Charles H. Shinn.

(Experiment Station Bulletin, No. 107.)

Comparatively small modifications in the structure, habits, and environments of a plant are capable of changing it from a harmless dweller by the wayside to a most aggressive enemy of the agriculturist. The law of evolution holds in the case of weeds as certainly as with flowers and fruit. Nature is producing new varieties of our common garden weeds, which every now and then appear and temporarily conquer wide territories of cultivated land. The so-called Russian thistle, or Russian cactus, poetically termed by the *moujiks* "the wind witch," belongs to the class of tumble-weeds, and furnishes an excellent illustration of these dangerous modifications in plant structure. But, before we attempt to describe this plant, it is necessary to state, in plain language, that it is not a thistle at all; nor does it in the least resemble a thistle.

When we look for the parentage of this Russian "tumble-weed," we find that there is a common salt-wort, *Salsola kali*, known since early settlement along the Atlantic seacoast, and described by Linnæus as growing in Eastern Europe. The *Salsola* does not spread rapidly, and has never developed dangerous qualities as a weed, so far as studied in its normal form. But a sub-species, or variety—botanists have hardly determined which to call it—seems to have been developed in the course of centuries on the immense plains of Russia and Siberia. This sub-species, slowly adapting itself to its environments, and struggling for life with other native plants of the desert and the "black lands," became the *Salsola kali tragus*, the so-called Russian thistle of to-day, a weed whose eradication now taxes the best energies of the American farmer in Dakota.

The *Salsola* belongs to the *Chenopodiaceæ* family. Among its relations are several species of *Atriplex,* shrubby plants of the desert; the pig-weed, goose foot, lamb's quarter, etc., *Chenopodium;* the greasewood, *Sarcobatus*, and another rolling weed, *Cycloloma atriplicifolia.* Botanically, therefore, it belongs with some of the worst weeds known to agriculture. It is an herbaceous annual, diffusely branching from the base, and forming, under favorable conditions, a round, firm head, from one and a half to three feet high, and twice as broad. Its growth is extremely rapid, and the plant hardens so as to be quite thorny as early as August. Like the common tumble-weeds of California and the middle West, the season of rolling is in the fall, when the action of the wind causes the root to break at the surface of the ground, and the plant is blown about over many miles of territory, and often for many successive weeks. The seeds are held in place in the axils of the bracts by two minute tufts of coiled hairs, which prevent them from falling all at once. A large mature plant will sometimes bear from 100,000 to 200,000 seeds, and the method in which these seeds are borne, as explained above, distributes them over an immense area. The popular literature of the subject is full of stories which illustrate this point. In one instance, a farmer is said to have labeled a Russian thistle, and twenty-four hours afterward the plant was discovered sixty miles away.

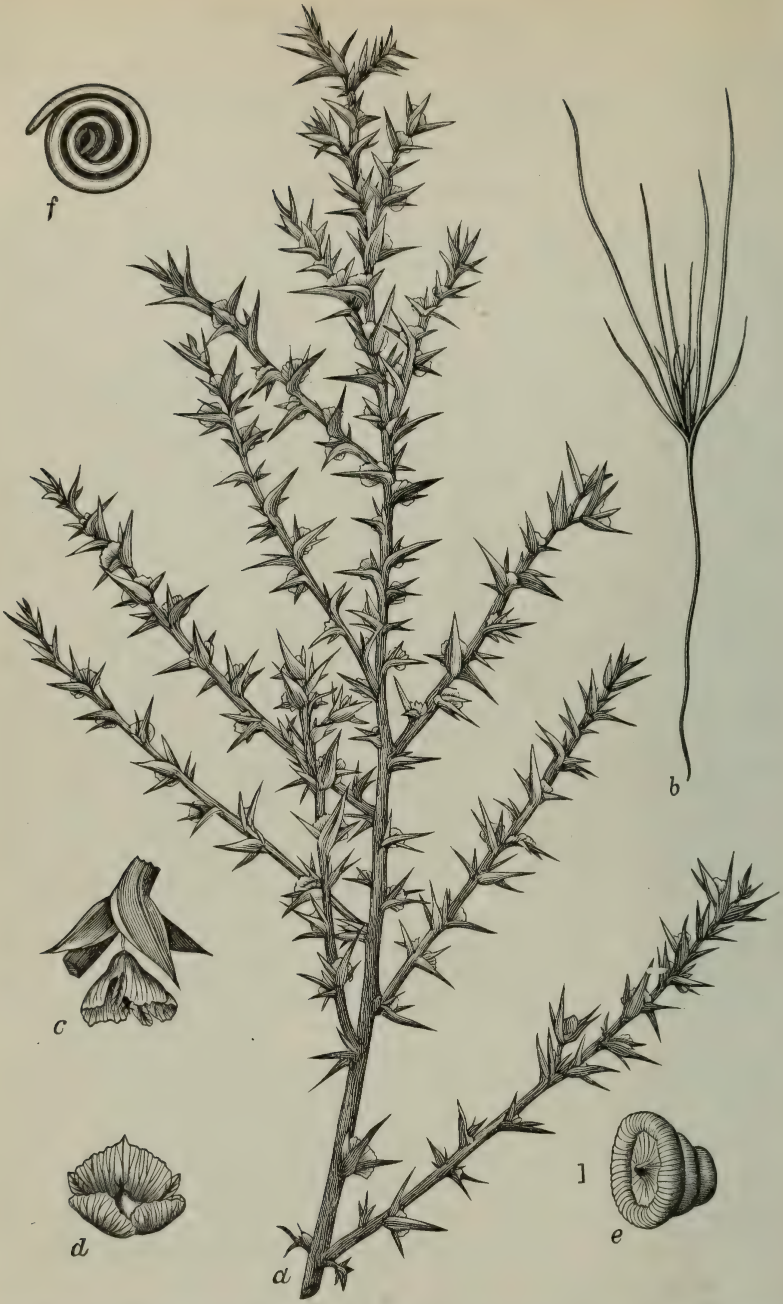

Plate I. Russian Thistle.—Fig. *a*, branch of mature plant, natural size; *b*, seedling about two weeks after germination, natural size; *c*, flower detached from the axil and remaining suspended by minute hairs, in the ordinary inverted position on a rolling plant, enlarged three diameters; *d*, flower viewed from above and in front, showing the calyx lobes connivent into a cone-shaped body, and the large, membranaceous, spreading wings, enlarged three diameters; *e*, seed with flower parts removed, enlarged five diameters; *f*, embryo removed from the seed, enlarged seven diameters. (This cut and that of Plate II were furnished by the Agricultural Department, Washington, D. C.)

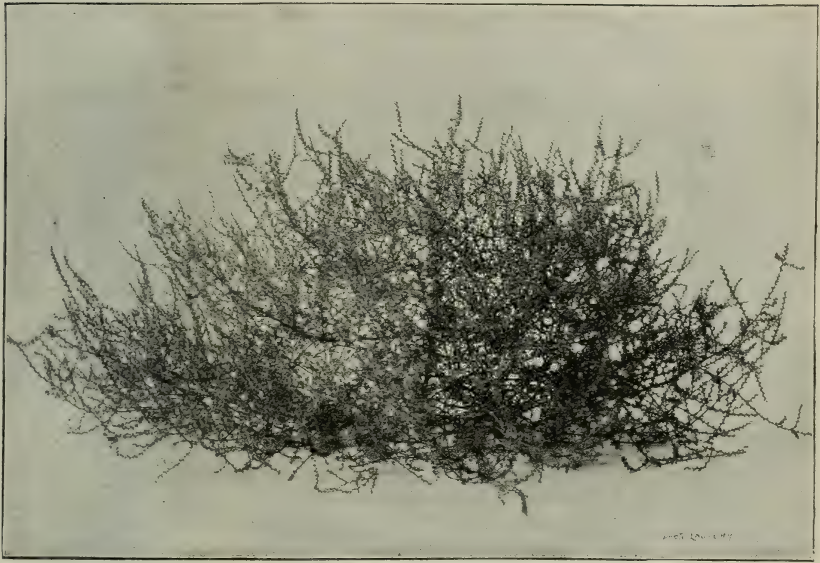

Plate II. Russian Thistle, Loosely Branched.

Technical Description.—The United States Department of Agriculture, Division of Botany, Bulletin No. 15 (1894), publishes the following technical description, as drawn by Prof. L. H. Dewey:

"*Salsola kali tragus* (L.) Moq. in D. C. Prod. XIII, 2187 (1849). Herbaceous annual, smooth or slightly puberulent; tap-root dull white, slightly twisted near the crown; leaves alternate sessile, those of the young plant deciduous, succulent, linear or subterete, 3 to 6 centimeters (one to two inches) long, spine-pointed, and with narrow, denticulate, membranaceous margins near the base; leaves of the mature plant persistent, each subtending to leaf-like bracts, and a flower at intervals of 2 to 10 mm. (about one twelfth to five twelfths of an inch), rigid, narrowly ovate, often denticulate near the base, spine-pointed, usually striped with red, like the branches, 6 to 10 mm. (three twelfths to five twelfths of an inch) long; bracts divergent, like the leaves of the mature plant, in size and form; flowers solitary and sessile, perfect, apetalous, about 10 mm. (five twelfths of an inch) in diameter; calyx membranaceous, persistent, inclosing the depressed fruits, usually rose-colored, gamosepalous, cleft nearly to the base into five unequal divisions about 4 mm. (one sixth of an inch) long, the upper one broadest, bearing on each margin near the base a minute tuft of very slender coiled hairs, the two nearest the subtending leaf next in size, and the lateral ones narrow, each with a beak-like, connivent apex, and bearing midway on the back a membranaceous, striate, erose-margined horizontal wing about 2 mm. (one twelfth of an inch) long, the upper and two lower wings much broader than the lateral ones; stamens five, about equaling the calyx lobe; pistil simple; styles two, slender, about 1 mm. (one twenty-fifth of an inch) long; seed one, obconical, depressed, nearly 2 mm. in diameter, dull gray or green, exalbuminous, the thin seed-coat closely covering the spirally-coiled embryo; embryo green, slender, about 12 mm. long when uncoiled, with two linear, subterete cotyledons."

Introduction into the United States.—For many years the thistle has been a destructive weed in the barley, wheat, and flax fields of Russia. It is even said that large areas near the Caspian Sea have been abandoned to this weed, which is continually extending to new territory. In 1873, some impure flax seed brought from Russia, and sold in Scotland Township, Bon Homme County, South Dakota, contained seeds of this dangerous tumble-weed. A map compiled by the Agricultural Department, in 1894, affords an easy means of tracing its extension from Bon Homme. It seems to have taken nearly ten years for it to extend over the adjacent counties of Yankton, Douglas, Davison, Hutchinson, Hanson, and Aurora. Probably during this decade it really obtained foothold, in a small way, over the larger part of North and South Dakota, but it hardly excited much serious alarm until 1880. After 1884, its advance was much more rapid, and by the close of that decade (1884–1894), it was causing extensive damage over half the area of the Dakotas, and was recognized as rapidly gaining possession of the other half. Following along the lines of travel, and carried downward by irrigation ditches, it had appeared in many widely isolated spots, each one of which was a new center of infection. It was already recognized as extremely dangerous in Minnesota, Wisconsin, Iowa, Nebraska, Illinois, Ohio, and Colorado. It had reached the British line on the north, Kansas on the south, and Oregon on the west.

The Government reports, from which these facts have been obtained, state that "the rapidity with which the thistle has spread, both in infecting new territories and in thoroughly covering that already infected, far exceeds that of any weed known in America. Throughout about twenty-five thousand square miles it is very troublesome, and is causing a large amount of damage." Other official reports place the losses of the wheat farmers of Dakota from this cause, in 1894, at over $2,000,000, a sum nearly equal to their annual State and county taxes.

The local distribution of the Russian thistle is chiefly by means of the winds. When the ground is hard, the light, round masses, as previously noted, are driven for miles, scattering seeds along their track. Gusts of wind beat them back and forth, covering all the intermediate areas, and sometimes the light seeds are blown from place to place independently. But this local distribution would not of itself have brought the weed to California for many years to come. The seeds are sent abroad in badly cleaned cereals, flax, and other field crops, although they are small and so easily separated that only gross carelessness can cause much danger from this source. The seeds, however, are more often carried long distances in the bedding and litter of stock-cars, or in crevices in freight or machinery packed on flat-cars. Emigrants may also convey such seeds over considerable areas in the feed of their animals and in their wagons. A moment's thought will suggest almost an infinite number of methods by which such seeds can be disseminated and carried from one part of the country to another in a very brief space of time.

Injury Caused by the Plants.—Like any other weeds, the thistle, when quite small, is often eaten by stock, especially sheep, but this is for so short a period in the flush of spring, when grass is abundant, that its value as a forage plant is not worth considering. Wherever it becomes established, it excludes all other plants, and draws much nourishment from the soil. In this it is like all other weeds, but it increases more rapidly, hence taking more space than others, and it seldom decays on the ground where it grows. In fields of hay and wheat, it pushes up into long, straggling stems, which cannot blow over the country, but which ripen very early in the season, greatly lessening the value of the crop, or sometimes entirely ruining it. The stiff, thorny weeds make it hard to run harvesting machinery, and very much annoy both horses and men. The plant thrives on high, dry soil, and will also grow on strong alkali. In fact, it is difficult to mention any kind of soil unsuitable to the Russian thistle. The injury done in cultivated crops is less than in wheat fields, because the thistle is easily killed by cultivation. But the recognized presence of the thistle in California should put an end forever to the system of slovenly summer-fallows which one so often sees. Unless summer-fallowed land be kept free from weeds all the season, one cannot be sure of having a clean grain plot the following year.

Station Literature on the Subject.—The first official report respecting this tumble-weed thistle in America was in 1891 (Report of the Secretary of Agriculture). Therein the plant was described; early fall plowing was recommended as a check to its progress, and State legislation was suggested. A bulletin was published in 1892, and a more complete one, with maps and illustrations, appeared in 1894, portions of which have been largely republished, and plates from which appear in the present report. Meanwhile, other students were in the field. Prof. C. E. Bessey, of the Nebraska station; Prof. H. L. Bolley, of North Dakota; Prof. E. S. Goff, of Wisconsin, and a number of others, published reviews, pamphlets, and the results of more or less local investigations. From Iowa to Oregon, and from Dakota to Arizona, public interest in the weed has taken shape in an abundant literature. At the last session of Congress, a bill was introduced providing for the appropriation of $1,000,000, with which to pay men to destroy the pest, but the opinion prevailed that it was public policy to leave the matter wholly to the townships, counties, and States more directly interested. As the weed extends to new districts, the newspapers and other publications take up the subject, with many local variations, so that a bibliography needs constant revision.

One of the most graphic papers upon the subject is a brief memorandum by Professor Budd, of Ames, Iowa, upon "The Russian Thistle in Its Native Home." He quotes from Professor Henfrey's book, "The Vegetation of Europe, Its Condition and Causes," as follows: "On the steppes east of the Volga one curious thorny plant has attracted the attention of most travelers—the "Wind Witch," or "Leap the Field." It forms a large, globular mass of light, wiry branches interlaced, and in autumn decays off at the roots, the upper part dying. It is then at the mercy of the autumn blasts, and thousands of them may be seen coursing over the steppes, rolling, dancing, and leaping, often looking at a distance like a troop of wild horses. It is not uncommon for twenty or more to become entangled in a mass, and roll away like a huge giant in seven-league boots." Professor Budd says that east of the Volga and south of the Caspian, he met with it everywhere. In the field of cereals, it is not regarded as specially troublesome—quite contrary to American experience—because the Russian varieties of grain appear to tiller out more than with us, and are sowed very early and thickly, so that the thistle plants are said to make little progress. In this region are found vast alkali tracts, which are used for pasturage, and here the thistle is found mingled with wormwoods, sages, mulleins, true desert thistles, and a multitude of other plants. West of the Volga, in the black soil region, the plant was found everywhere, but none were permitted to ripen along the railways or roadsides. The officials enforced very stringent enactments, and have, so far, protected the immense sugar-beet fields. In southeast Orel and Kiev, the sandy and heavy clay soils are alike said to be overrun with the Russian thistle. Professor Budd thinks that it is a comparatively harmless annual as managed in Russia, but he recognizes the fact that it is a far more serious pest in the United States, where people will not accept the severe legislation of eastern Europe. He says: "It will spread over the unfenced pastures more rapidly than any weed yet introduced. But in fenced regions it will not, in the end, prove as serious a pest as the Canada thistle." The worst danger point, he thinks, will be the alkaline plains of the Northwest and West. This may be considered as a timely warning to the people of the San Joaquin and Sacramento Valleys.

A brief paper by Professor Bolley, published in March, 1895, in Bulletin No. 17 of the North Dakota Experiment Station, gives the results of experiments about the distribution of weed-seed by the winter winds.

He says, in speaking of the thistle, that those who advocate the use of hedges or fences to stop its encroachments, have in mind only the rolling character of the weed. All weeds, if allowed to mature, are distributed to some extent by the winter winds, as nearly all are supplied with special appliances such as vanes, lint, or light pods, which assist in their dissemination. Professor Bolley measured the surface of an early winter snowdrift, on plowed ground, ten rods from any standing weeds. The snow was three inches deep. Two square feet of this drift contained thirty-two seeds, representing nine species. In another experiment, he poured one peck of mixed seeds upon the crusted snow when a wind was blowing at the rate of twenty miles an hour. Thirty rods distant, at right angles, a three-inch trench in the snow served to catch drifting seeds. In ten minutes, many seeds of all species were in the trench, and the lighter seeds had been carried over it. Many similar experiments had been carried on, and the conclusion reached was that weed-seed of almost any size, especially the thistle, traveled for miles with drifting snow, and were buried in the ground when the snow melted. If the thistle is ever disseminated in the more alpine regions of California, the same method of distribution will be dangerous here. It must also be remembered that seeds will be very easily blown long distances over the hard surface of our plains in the autumn, before the early rains cause the growth of vegetation.

Representative Legislation Elsewhere.—The weed laws of these several States are seldom well enforced; but perhaps the best laws regarding the Russian thistle are those passed by the Legislatures of the States of North and South Dakota in 1890 and 1891, and still in operation. Similar provisions, if placed on the statute books of California, and carried out in every county where the thistle appears, would soon bring it under control. During the time which must elapse before the next session of the Legislature, the only remedy in California is to be found in prompt action by County Supervisors and local associations.

The South Dakota law provides that "every person and every corporation shall destroy, on all lands which he or it may occupy, all weeds of the kind known as Russian thistle, Canada thistle, and cocklebur, at such time as the Township Board of Supervisors or the Board of County Commissioners may direct." The time chosen and the method of destroying weeds is to be in such a manner "as to prevent their bearing seed." Every road overseer is to destroy such weeds on the highways, also upon adjacent unoccupied land neglected by the owners, and the cost of the latter service is to become a lien against the land. Any land-owner or lessee of land, or county or township supervisor or overseer, failing to comply with the requirements of the law, shall suffer various fines and penalties, such fines going to the general fund of the county in which action is brought by the State or District Attorney.

The laws of North Dakota apply to mustard, wild oats (*Avena fatua*), "French weeds" (*Thlaspi arvense*), as well as the Russian thistle, Canada thistle, and cocklebur. Each Board of County Commissioners is ordered to declare the time and manner of destroying noxious weeds, at its regular meetings in April, each year, and its rules shall be published in the newspapers, or posted as election notices are posted. In case of neglect or refusal to destroy these weeds on the part of any individual, firm, or corporation owning or occupying land, it shall be the duty of the road officers, after ten days, to destroy the same, and the expense becomes a separate tax against the land, to be made a part of the next tax-roll. The neglect or refusal of any road officer to destroy these weeds subjects him to a fine of $50.

The laws in Ohio are very complete. An Act of February 17, 1894, imposes a fine of $20 upon any dealer who knowingly sells impure seed; and a similar fine is imposed upon "whoever, being the owner, occupier, or possessor of any land," suffers weed-seed to ripen thereon or on the highway adjoining the same. Another Ohio Act of April 29, 1895, gives the township trustees power to destroy noxious weeds, and the cost is collected as a tax, while the trustees receive $1 a day for their supervision. A much more complete statute, passed April 25, 1893, requires the superintendent of roads, county supervisors, and street commissioners to destroy "all brush, briers, Canada or common thistles, or other noxious weeds" within their jurisdiction, for a fortnight in each of the three months of June, August, and September of each year. Any farmer who destroys such weeds on the highway fronting his ground, shall be allowed a reasonable compensation credited on his tax-list. Any road-company who fails to do this work shall be liable for the costs, together with 100 per cent penalty, together with the cost of action. Similar provisions extend to cities and incorporated villages.

California Legislation.—There are no laws in California which apply, by name, to the Russian thistle, but there are laws under which the weeds can be eradicated. The first California Act aimed at any noxious weed was that of March 2, 1872, which, curiously enough, applied only to Scotch or Canada thistle in the counties of Humboldt, Siskiyou, Klamath, Del Norte, and Alameda. The Act made it unlawful for any land-owner to permit seed to ripen or to be scattered abroad, or to knowingly sell any seed or grain containing thistle seed. It imposed a fine of $100 for any violation, and the same fine upon road overseers who allowed the thistle to mature along the highways.

Section 28 of the County Government Act of March 14, 1883, also reaffirmed by the Act of March 31, 1891, and again in 1893, ordains that Supervisors have the power to provide for the destruction of gophers, squirrels, other wild animals, noxious weeds, and insects injurious to fruit trees. This is the law under which work must be done at the present time, wherever the thistle appears outside of incorporated towns. It is sufficient to authorize extensive and well-considered expenditures of public funds in every county of California, and it is the law under which the Supervisors of Los Angeles County have felt themselves justified in spending money in the Lancaster district. The term "noxious weeds" is better, in this case, than the long lists of names of weeds incorporated in the laws of some of the other States, because so long as this law remains in force, every new weed that appears can be fought at once, instead of waiting for special enactment.

A letter received May 2d, from Lancaster, states that the Assistant District Attorney of Los Angeles doubts whether the county has a right to spend money to destroy weeds, except on public roads and in parks. If this view be sustained in the courts, the result will be disastrous in many districts. But the intention of the County Government Act of

1893, which is still in force, appears very plain, and if any objection is going to be made, the matter should be taken to the higher court by the County Horticultural Commissioner, or by some other public-spirited citizen. Any one who reads the law will note that reference is made, in the same clause, to noxious weeds and to insects injurious to orchards. Fruit trees certainly are seldom or never found in the public highway; and if the law does not limit the power of the Supervisors in this respect, it is difficult to see how it can be limited in regard to noxious weeds.

Within incorporated towns, the California Act of March 11, 1893, is in operation. This Act provides for the planting and caring for shade trees in towns, and for the eradication of weeds therein. It provides that the city council or trustees of any municipality "may condemn, as public nuisances, any weeds whose seed are of a winged or downy nature and are spread by the winds"; and they may compel the eradication of such weeds by the owners of any lots upon which they grow, or may charge the expense upon said owner. This law, also, will be of great service, although it is probable that stronger penalties should be attached, not only in the case of municipalities, but also in the law defining the powers of Supervisors in this regard. It is plain, however, that there need be no difficulty in finding laws under which to organize coöperative efforts to destroy the Russian thistle.

Appearance in California.—It has been known, for some time, that the thistle had obtained a foothold in California; and energetic efforts have been made to destroy it. A sample of the weed was exhibited at the Fruit Growers' Convention in Sacramento, in 1894, and excited a good deal of interest. This led to correspondence with the United States Department of Agriculture. The following letter from one of the Government botanists contains a good deal of practical information:

UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF BOTANY,
WASHINGTON, D. C., January 25, 1895.

PROFESSOR E. W. HILGARD, *Director Agricultural Experiment Station, Berkeley, California:*

DEAR SIR: During the past two weeks the Division of Botany has obtained two specimens of the Russian thistle from Lancaster, Los Angeles County, California. These specimens confirm the report, previously received, that this dangerous weed had been introduced at that place. It is said to be distributed over an area of about ten miles long and four or five miles wide, in the desert about Lancaster, and to be most abundant about the station of Lancaster, where there is water.

The nature of the surroundings are such that it can do but little harm where it is at present. Even if allowed to obtain a foothold, it might not become more troublesome than some of the worst weeds you have at present. Its behavior in some of the irrigated lands in Colorado and in southern Idaho, indicates, however, that, if allowed to spread, it will quickly take rank with your most troublesome weeds, and will prove itself an evil worthy of vigorous repressive measures. In its present condition, extermination seems possible, and even practicable. If allowed to spread, as it is certain to do within two years if left undisturbed, extermination will be practically impossible, and a continuous war for subjugation will have to be waged against it, as is now the case with this plant in the Dakotas, and with ragweed, ox-eye daisy, and wild carrot in the East. Statements have been made that the Russian thistle will not thrive on well-watered and well-tilled farms. My own observations of this plant lead me to think that it will thrive in such situations as well, and even better than in dry or sterile soil, and that, if once allowed a foothold in such farms, it is likely to prove as troublesome as any of our annual weeds.

Very truly yours,

L. H. DEWEY,
Assistant Botanist.

A second letter from Mr. Dewey, under date of February 23d, adds that "information has been received, chiefly from Mr. John Scott, Commissioner of Horticulture, Los Angeles, and from Mr. Abbu Dunning, Postmaster at Lancaster. A letter just received from Mr. Scott states that he has unconfirmed reports that the Russian thistle is south of Tulare City, and also between Pixley and Tipton. Mr. A. H. Leckenby, of Bakersfield, writes that the Russian thistle has been reported as growing in Kern County, but as yet he has been unable to verify the report." If the thistle is indeed established south of Tulare City, it must be some distance outside of the town limits, as on April 6th the writer, together with Mr. Julius Forrer, foreman of the Experiment Station near Tulare, made a careful examination near the railroad tracks, ditches, and roadsides in and around the town, without discovering a single specimen of this obnoxious weed.

While corresponding with the Department at Washington, it was ascertained that Mr. W. S. Melick, proprietor of the Lancaster "Gazette," quite an extensive land-owner in Antelope Valley, was especially well posted upon the subject, and he placed himself at the service of the Experiment Station.

Under date of February 10th, Mr. Melick wrote: "You can do nothing studying the Russian thistle until later. It has not begun to grow yet. About April or May would be the time to see it here. Our altitude makes all crops late. There is no doubt but that this is the true Russian thistle. It has been here four or five years, but it has not spread much. This is a desert town, surrounded by sagebrush, so the thistles which grow get lodged in the sagebrush, and do not travel far. By the advice of Horticultural Commissioner Scott, under the Board of Supervisors, all last year's crop has been burned. As the land about Lancaster is not farmed much, few farmers are bothered with it much yet. The only way to get rid of it is by prompt, vigilant action by Boards of Supervisors or the State authorities."

Visit to Antelope Valley.—In accordance with Mr. Melick's suggestion, the writer waited until some growth had been made before visiting the infected district. April 3d and 4th were spent in the town of Lancaster, and its immediate vicinity. The area over which the weed to some extent prevails, spreads over about eleven sections of land. As noted by Mr. Melick, it first appeared in the streets of the town near the railroad track, several years ago, probably brought in by cattle cars, as there is very little immigration by wagon across this district. The weed naturally attracted little attention at first, but last year it excited a great deal of alarm, and Mr. Melick and others began to organize public work. The County Supervisors wisely agreed to spend some money, and men have worked more or less during the last winter burning the old weeds, and were then harrowing-under the young plants wherever they appeared. About $400 has been spent in this manner. It is hardly necessary to say that this work merits the approval and hearty support of every citizen and newspaper in Los Angeles County. If the expenditure of $10,000 would utterly destroy the Russian thistle in the Antelope Valley, it would be a good investment.

The country which may be termed the present headquarters of the Russian thistle in California, is a level plain of rich, sandy soil in the southwestern portion of the famous artesian belt of Antelope Valley. Antelope Valley lies along the borders of Kern, south of the Tehachapi, and north of the La Liebre Mountains. It contains 1,100 square miles of territory, and has an average elevation of 2,600 feet. Although the rainfall is light, the valley contains a number of colonies, whose lands are irrigated from streams and reservoirs, a famous grain belt of 70,000 acres lying along the southwestern hills, and the artesian belt already referred to. A large area is undoubtedly incapable of irrigation, and receives too little rain to make it reclaimable. If the Russian thistle extends over these waste and barren sections along the middle of the valley, and extending east to the Mojave and Colorado deserts, or if it escapes into the mountain cañons, its entire destruction will become impossible. But it can certainly be conquered in all the colonies and plow lands. It can also be choked out in every well-grown alfalfa field.

The first offshoot from the original thistle colony has already appeared about ten miles west, in sections 24 and 25, township 7, range 14. This is in the edge of the grain belt, and unless destroyed, the thistle will soon appear along the whole line of the foothills. The wheat grown here is of the finest quality, and much of it is hauled out through the Tejon Pass. It is also shipped to Los Angeles and other points along the railroad. If every farmer take pains to plant only clean seed, and if the rolling weeds be destroyed, this small colony will soon disappear under close cultivation. But, directly west, lie the pastured foothills and the mountains that surround Elizabeth Lake. There is, therefore, extreme danger that the weed will become naturalized in this thinly settled mountain region, which extends all the way to Ventura. Immediate action is, therefore, necessary.

Returning to the original thistle colony at Lancaster, the artesian belt covers about eighty-eight square miles, and already contains eighty-three flowing wells. But these are scattered, the region being still thinly settled, and one often finds a few acres of alfalfa, grain, or orchard surrounded by native desert. The sagebrush and other shrubby growths standing upon little mounds of sand, and the belts of tree yuccas have served the excellent purpose of preventing the thistle balls from moving far or rapidly, even under the wildest gales. Perhaps, from this reason, the thistle seems very widely sown in some portions of the infested district. There are places in the streets of the town where the slender reddish leaves of the plant, much resembling a young pine, nearly cover the ground. It is very easily destroyed, however, with harrow or cultivator. The well-grown alfalfa fields seem to be little troubled, but where there is a poor stand, the thistle is coming up. Excellent work has been done by the employés of the County Supervisors, and it is now difficult to find a single specimen of last year's weeds. In the town itself, all the young plants can easily be reached and destroyed. On the uncultivated territory, the case is much more difficult.

Another letter received from Mr. Melick, early in May, 1895, inclosed samples of the thistle after about six weeks' growth. They have begun to branch strongly, are about six inches high, and are becoming too hard for even sheep to nibble. Mr. Melick said the young plants were extremely abundant, but could be destroyed by the first of August.

The weed was next found along the Armagosa Creek wash, which extends from Lancaster south, along the railroad, for about five miles, and then stretches off in a southwestern direction, to the Leonis Valley. The late spring rains caused unusual growth, and there was evidently no time to lose. The Agricultural Department of the University, by publishing a bulletin on the subject, and distributing it widely throughout the State, called the attention of the leading newspapers, the Boards of Supervisors, and the public generally, to the great importance of the subject. This was in May, 1895, and the matter was taken up with especial vigor in Los Angeles City and County. Mr. Melick, writing again in October, stated that the energetic work of the citizens and officials had greatly reduced the area of the thistle, and that it now seems under control in Antelope Valley. He added that this was in great part due to the University bulletin of May, 1895, which did much to arouse the land-owners. The season of 1895 was, in some respects, unfavorable to the thistle in this section, and it will be necessary to see how matters look another spring; but Mr. Melick's report is certainly very encouraging, and shows plainly what can be done by a small and isolated, but energetic, community, with proper assistance from the county under the general law.

Distribution from Antelope Valley.—At first thought, Antelope Valley appears to be at some distance from the main lines of travel, and a point from which distribution would be slow and difficult. On the contrary, few points in the State are more immediately dangerous. There is a strong probability that the thistle has already been carried southward, along the line of the railroad, into San Fernando Valley, and the branch railroad from that point affords easy access to Ventura and Santa Barbara. In a very short time, unless controlled, the weed will move eastward to the line of the Atlantic and Pacific, and northward into the San Joaquin. In fact, it has already crossed the Tehachapi range, and has made its appearance in Kern County. A letter, in the summer of 1895, from G. F. Weeks, editor of the "Daily Californian," of Bakersfield, says: "It is growing here from seed evidently scattered from cars that have come through Nebraska, or some other infected district, as, at present, it is found only along the railroad tracks." As previously explained, however, the thistle may have reached Kern County by way of Tejon Pass, through which there is a great deal of travel to and from the Antelope Valley; but it is evident that the same cause which first brought the weed to California is likely to continue in force, and we may expect it to appear in many parts of the State. Judging from the experience of South Dakota, it is probably already growing, unsuspected, by many a roadside and in many a pasture. Unconfirmed newspaper reports of its presence have recently come from Gilroy, San Benito, and San Luis Obispo.

During the present season every effort should be made to locate the various points of infection in both Northern and Southern California, and determine their areas. The only dependence, in the determined warfare that must continue to be made, must be upon thorough local organization. If farmers will destroy the weed upon cultivated land, and if the county authorities will destroy it upon roadsides and over uncultivated places, the railroads and other corporations will probably be willing to do their share. The railroad companies, irrigation companies, and similar corporations have a large interest in the matter; but the whole community must be aroused, or the work will not be done.

Suggested Remedies.—Since the plant is an annual, it is easily killed during the growing season. For three months from the time it sprouts, no good farmer need be afraid of it, but, according to the Dakota experience, concerted action is necessary. The fundamental principle of the contest must be: *No Russian thistle should be allowed to produce seed.*

The vitality of the seed, as compared with other annuals, appears to be low. The conditions affecting seed vitality are moisture and heat. The seeds of this plant crack, and the germ is destroyed by a low degree of dry heat. Hence, when stubble and pasture fields are burned over in the autumn, the larger part of the thistle seed will be kept from germinating.

The tap-root will not sprout again when cut at the surface, and if the plants are plowed under, they perish as easily as mallows. In orchards, vineyards, beet fields, and all lands devoted to hoed crops, there should be no trouble with respectable cultivation. But if the farmer stops at the limit of his cultivated land, he must do the same work every year. Fence corners, creek borders, and waste places of every description must receive the same attention, or the Russian thistle will again seed the fields. The slipshod cultivation so often seen, even in the most fertile parts of California, and perhaps endurable with less aggressive weeds, though never advisable nor profitable, becomes entirely impracticable after the Russian thistle once obtains foothold.

The Minnesota Experiment Station bulletin lays great stress upon the use of what is called the "green-manure fallow" in cultivated lands. Modified to suit California conditions, this means to plow shallow with the first rains, and sow burr clover, or some similar crop, to plow under, with the ground thistles, for a green-crop fertilizer. After the first plowing, one must go over the field and hoe out any stray plants.

If the thistle is found in grain fields, it would be better to cut for hay as early as possible, and plow the stubble under, without waiting for the aftermath. A second plowing may also be necessary. In most sections this system will clear the grain fields in two seasons, if no seeds are allowed to blow into the fields.

As soon as the grain crops are harvested, the stubble and weeds should be burned in every case where the thistle has appeared. In our dry climate this is very easy, and it has been suggested that the use of a header, as leaving a greater amount of stubble, furnishes the material for more thorough burning. Especial attention should be paid to any patches in the grain field where a poor stand of grain has allowed the thistle to develop into large "tumblers."

Well-graded highways are usually kept clean by dressings with a reversible road-machine, and by vigorous use of the hoe on the narrow borders. Wide, unutilized road spaces are difficult to deal with, and often will have to be plowed and cultivated. Attention should be paid to the road ditches, whose sides should be so sloping that they can easily be cleared from top to bottom. Along infested highways the cultivation should extend to the wheel-tracks. The scythe seldom cuts low enough, as the thistle branches so close to the ground that many seeds would be left. Burning is preferable, or the hoe. Professor Bolley says: "A small force of workmen is sufficient to destroy all the weeds along road margins of the worst infested townships. A foreman on horseback, constantly inspecting the work of a dozen men, can rapidly get over the country."

In order to prevent the large weeds from rolling, the Russians plant belts of sunflowers, which stop the plants, collecting them in high banks, and they are then burned. Belts of trees, or any other windbreaks, answer the same purpose, as do fences, excepting that the weeds must be raked back so as not to injure trees or fences when fires are set. This is, of course, expensive on a large scale, and there is no doubt that the time to fight the thistle is when it can still be plowed under. In Dakota, the farmers harness ten or twelve horses by long ropes to immense bars of wood and draw very large heaps of weeds together to be burned. Any work of this kind should be followed by burning the stubble, and two plowings before another crop.

Our system of managing orchards gives us every advantage. The California orchardist keeps the surface of the ground clean and mellow, often by two plowings, and by a great number of cultivations, with deep-cutting, narrow blades or "chisel-teeth." While the first and second crops of weeds are often turned under, to decay during the rainy season, no later growth of weeds is allowed. Under this system, all-important to the growth of high-class fruit at the least cost, the most dangerous of perennial weeds can be destroyed in a few seasons by increasing the frequency of the cultivations, and certainly no annual like the *Salsola* could survive a single year.

In cities, towns, and villages, special care is needed, not only on the streets and sidewalks, but also upon unoccupied lots. In California, as in the Northwest, the points of infection usually begin at or near the railroad stations, and townspeople and merchants should make stringent regulations to suppress the thistle at its first appearance, and not allow it to escape into the farming country to lessen the value of town property. The owners of lots should combine and break up every neglected piece of ground, sowing it to alfalfa, or, where water cannot be obtained, to such a plant as the Australian saltbush (*Atriplex semibaccatum*). It is needless to say that this would make our towns and villages look much neater. A town ordinance should tax non-residents for such necessary improvements, and town trustees have the power to pass such an ordinance.

When the United States Department of Agriculture sent out circular letters for information, one question read, "In what manner was the Russian thistle introduced?" The bulk of answers were: "By the wind," and "impure seed." Considering the second cause, it may be said that many small threshers do not thoroughly clean the grain, and thistle seeds, or pieces of stem containing seeds, may easily find their way into the sacks and be sowed again the following season. Poor (or careless) farmers who buy cheap grades of seed grain, or flax, or clover, or millet, may obtain a liberal stand of thistles without extra charge. The papery flower-parts of a thistle often adhere, even after passing through a threshing-machine, so the mass varies considerably, from naked seeds as large as a clover and about half as heavy, to pieces the size of a melon seed. If the fans are properly adjusted, thistle seed can be blown out even from flax or clover, but it is much more difficult to separate them from grains of millet. Fortunately, the California farmers do not grow millet extensively, but we grow a good deal of flax for oil, and the coast districts devoted to that crop should pay special attention to the subject of sowing clean seed.

Some General Considerations.—From the preceding pages, the reader will conclude that while the Russian thistle is dangerous, it can be conquered by persistent work. Many other weeds, when well established, furnish more trying problems to the individual farmer. The small morning-glory, or wild convolvulus of our rich bottom lands, is infinitely harder to destroy.

We may classify all weeds, from the cultural standpoint, as either annuals, biennials, perennials with underground creeping rootstocks, and perennials without creeping rootstocks; (rootstocks are really underground stems with buds). In order to know how to fight a dangerous weed, it is necessary to study its root-system and method of propagation, and then the proper method to exterminate the weed can readily be ascertained. To some extent, these classes intermingle. A weed which is an annual in one country, owing to climatic conditions may be a biennial or a perennial in another country; but the root-system offers a more stable basis of comparison. The annuals may again be divided into those which ordinarily live and die in the same place, and those "tumble-weeds," such as the subject of this report, which traverse a considerable region before their power for mischief has come to an end.

Decidedly the most troublesome class of ordinary weeds are those perennials with permanent roots, whether creeping or not. The ordinary species of *Rumex* (the common docks of our fields), the plantains, the ox-eye daisy (*Leucanthemum vulgare*), and the goldenrods, are illustrations of one type, while the wild morning-glory, the wild licorice (*Glycyrrhiza lepidota*), the Canada thistle, and the ordinary mint have the horizontal rootstocks, which, as previously stated, are really creeping underground stems, every joint of which will make a new plant. The Russian thistle is bad enough, and, to some portions of California, seems peculiarly threatening, on account of the rapidity with which it can spread over large areas, but in the rich and thickly settled valleys, where intensive horticulture is understood and practiced, it can never be as troublesome as such a perennial as *Convolvulus Californica*, so vexatious to vineyardists.

Lines of Further Work.—Now that we know of the presence of the Russian thistle in California, and have the experience of other States to guide us, it should be our first duty to map out the areas of distribution, no matter how small. The Experiment Station invites farmers, land-owners, road overseers, supervisors, and all persons interested in the agricultural welfare of California, to send samples of weeds suspected of being the Russian thistle to the Director, Professor E. W. Hilgard, for determination. We invite further correspondence on the subject, and in all cases where it seems advisable, a representative of this department will go to any part of the State, either to identify and map out suspected infection centers, or to give information on the subject. If the only colonies we now have are those extending from the Antelope Valley, an energetic campaign ought to complete the conquest of the enemy. As previously stated, it is most important to guard the lines by which the weed can enter the State from Oregon, Nevada, and Arizona. It is especially necessary that the dwellers along the main railroad lines should know the thistle when they see it, and should be prepared to act in unison. Especial attention should be paid to the upper Sacramento region, to the country around Reno, to Auburn and other Sierra towns on the line of the Central Pacific, to the vicinity of Sacramento City, to the Mojave districts, and to the frontiers of San Bernardino. While devoting attention to the great interior valleys, however, we should not neglect to study the smaller coast valleys, where the use of impure seed may already have established unsuspected plantations. In short, it behooves California farmers to examine every portion of the State, and there is no county whose Supervisors should not be prepared to take active measures of self-defense.

TIMBER-PHYSICS IN CALIFORNIA.

By Charles H. Shinn.

The Department of Civil Engineering of the University is now devoting especial attention to forestry problems, and has recently commenced a series of investigations respecting the quality of Pacific Coast timbers, both native and exotic. In view of the concurrent investigations and the necessarily close relation between that department and the Agricultural Experiment Station of the University, it is thought best to present, in a general manner, the character of investigations involved in the subject, for which the coöperation of the persons most interested is desired, and for which an understanding on their part is necessary.

The greatest difficulties in the present state of scientific knowledge, respecting the underlying principles of forestry, are in the department of timber-physics. Here, indeed, there is almost room for the creation of a new science, or, at least, of a very large and comprehensive division of physiological botany, developed along broader lines than before. Here belong the multiform problems of soil-influence, climate-influence, variation of species and of individuals, ages and seasons of cutting—of all which can modify the ligneous cell-structures of growing plants, or the condition of the resulting timber at any time thereafter. Such vital investigations belong to the province of timber-physics, and upon their results depend the calculations of architects, engineers, builders, and all who use wood in any form whatever.

To the forester, timber-physics, in its larger aspects, is no less interesting and essential to his work than soil-studies and descriptive botany. Timber-physics gives him the results of his tree growth; measures for him its value in the market; helps to tell him how to plant, what to plant, and where to plant. In the timber product is written the life-history of the tree, and those who would aid nature in the manufacture of high-class lumber must know how to test the physical results.

If we go to the text-books, we shall find most of the attainable data gathered under the head of "strength of timber," which, for the most part, merely represents empirical results—useful, certainly, but of limited application to the service of the forester. The mathematicians have done much work in this field, calculating the strength of different building materials—wood, stone, and metal—and reducing the result of experiments in elasticity and resistance under tension, under compression, under torsion, and under all manner of complex strains, to general theorems and algebraic formulas. Nearly all of the older tests made, even by Governments and Boards of Admiralty, were upon various woods, as wood merely, having no life-history whatever. Hence, their tables and results are of interest only to mathematicians, and, in practice, must be extremely misleading. Timber tests, which are empirical and merely mechanical, have led, in the past, to great engineering disasters, to very faulty constructions, and, on the other hand, to immense waste of materials.

The true theory of modern timber studies is that the investigation shall subordinate the mathematician to the physicist. Our knowledge respecting the properties of the various woods of the world, not only as regards strength, elasticity, hardness, and endurance, but also in any or all physical properties, is very deficient at the present time, though decided advances have been made during the past decade. Some systematic attempts have been made to determine these physical properties, and practical wood-workers have acquired a vast body of empirical knowledge. Little of a reliable nature has been published, and almost no scientific comparisons have been made, from which trustworthy laws could be deduced.

If more were known of the physical properties of various woods, builders and architects would greatly specialize the adaptations of those woods to different uses. Millions of dollars' worth of fine Black Walnut, fit for furniture, has gone into fence-rails, posts, and firewood. Millions of feet of Hickory, Southern Chestnut-Oak, and of our California Tanbark Oak have been left to rot after the bark was taken, because the value of the wood was unknown. In some cases the wood actually contains more tannic acid than the bark, and it can be profitably extracted. Thirty million dollars annually are spent in this country for railroad ties, which last, on an average, only six years. If, by better adaptation in the choice of species, or in the preparation of ties, or by impregnating the wood tissues with sulphate of copper or other substances, the life of a railroad tie can be doubled, we shall relieve our forests of the burden of supplying (in round numbers) forty millions of ties annually. Such illustrations of the value of timber-physics might be indefinitely extended.

The Department of Civil Engineering of the University is in full coöperation with the Agricultural Department here, and with the Forestry Division of the United States Department of Agriculture. Its laboratory contains, among its costly apparatus, an Olsen testing-machine of 200,000 pounds capacity—by far the most powerful one on the Pacific Coast—besides many other machines of service in timber-physics. Professor Frank Soulé, who is in charge of the work, has issued a circular, from which the following is taken, and parties specially interested should correspond directly with him:

> A long and thorough series of experiments upon the various timbers of the Pacific Coast will be made, with the purpose in view of bringing forward prominently their good characteristics, and of obtaining complete and reliable scientific data concerning the best use of them in engineering. * * *
>
> Residents of the Pacific Coast, and particularly of the State of California, are cordially requested to coöperate in making these tests as extensive and thorough as possible. Mr. W. G. Curtis, assistant to the General Manager of the Southern Pacific Railroad (on account of the lively interest which he and his company take in the full development of the properties and characteristics of the building material of our coast) has kindly agreed to transport samples for tests to Berkeley. * * *
>
> In order to coöperate, as far as shall prove practicable, with the United States Department of Agriculture Forestry Division, which has given much consideration to tests of timber-trees of the Atlantic slope, and, also, to render our results comparable with theirs, the following are issued as the directions for selecting trees and preparing the sticks for shipment to the laboratory of Civil Engineering:

INSTRUCTIONS FOR THE COLLECTION OF TEST-PIECES OF PACIFIC COAST TIMBERS.

A. Object of Work.

The collector should understand that the ultimate object of these investigations is, if possible, to establish the relation of quality of timber to the conditions under which it is grown. Care in ascertaining these, and minuteness and accuracy of description, are all-important in assuring proper results. It is also necessary to select and prepare the test-pieces exactly as described, and to make the records perfect, as nearly as possible, since the *history* of the material is of as much importance as the determination in the laboratory.

B. Localities for Collecting.

As to the locality from which test-trees are to be taken, a distinction is made between station and site.

By *station* is to be understood a section of country (or any place within that section) which is characterized in a general way by similar climatic conditions and geological formation. "Station," then, refers to the general geographical situation. "Site" refers to the local conditions and surroundings within the station from which the test-trees are selected.

Choice of Stations.—For each species, a special selection of stations from which test-pieces are to be collected is necessary. It is proposed to cover the field of geographical distribution of a given species in such a manner as to take in stations of climatic difference and different geological horizon, neglecting, however, for the present, stations from extreme limits of distribution. Another factor which will determine choice is character of soil as dependent upon geological formations. Stations which promise a variety of sites will be preferably chosen.

Choice of Sites.—Such sites will be chosen at each station as are usually occupied by the species at any one of the stations. The determination of the number of sites at each station must be left to the judgment of the collector, after inspection of the localities. The sites are characterized and selected by differences of elevation, exposure, soil-conditions, and forest-conditions. The difference of elevation which may distinguish a site is previously set at five hundred feet. Where differences of exposure occur, a site should be chosen on each of the exposures present, keeping as much as possible at the same elevation, and under other similar conditions. Soil-conditions may vary in a number of directions, in mineral composition, physical properties, depth, and nature of the subsoil. For the present, only extreme differences in depth, or in moisture-conditions (drainage), and decided difference in mineral composition, will be considered in making selection of sites.

Forest-conditions refer, in the first place, to mixed or pure forest, open or close stand, and should be chosen as near as possible to the normal character prevailing in the region. If what, in the judgment of the collector, constitute normal conditions, are not found, the history of the forest and the points wherein it differs from normal conditions must be especially noted.

C. Choice of Trees.

On each site, five trees are to be taken, one of which is to serve as "check tree." None of the trees are to be taken from the roadside or open field, nor from the outskirts, but all from the interior of the forest. They are to be representative average trees, neither the largest or best, nor the smallest or worst, preferably old trees, and those which are not overtopped by neighbors.

The "check tree," however, should be selected with special care, and should represent the best developed tree that can be found, judged by relative height and diameter, development, and perfect crown.

There are also to be taken six young trees as described under D.

D. Method of Making Test-Pieces.

(a) *Mature Trees.*

(1) Before felling the tree, blaze and mark the north side.

Only sound timber must be shipped. Any logs showing imperfections may be shortened. Be careful to note change in position of test-pieces.

(2) Mark on butt-end of each log north and south line, writing the letter "N" on the north, and the letter "S" on the south side.

(3) Logs for test may be cut in lengths of twelve to eighteen feet. If not more than eighteen inches in diameter, they may be sent to the Civil Engineering laboratory simply squared by the saw. If larger than this, "a flitch," or four-inch plank, running straight through the tree from the north to the south side, these sides being carefully marked, will be best.

Write the same data on a card, and tack this fast with light staples.

E. Records.

Careful and accurate records are most essential to secure the success of this work. A set of specially prepared record sheets will be furnished, with instructions for their use. A transcript of the record must be sent to this office at the time of making shipment; also, such notes as may seem desirable to complete the record, and to give additional explanations in regard to the record and suggestions respecting the work of collection. Original records and notes must be preserved, to avoid loss in transmission by mail.

INVESTIGATION OF HUMBOLDT REDWOOD.

Professor Soulé recently issued a special bulletin, giving the results of tests made upon that valuable Pacific Coast timber, the Redwood (*Sequoia sempervirens*). The following were the results:

Average specific gravity of 126 pieces	0.48
Average weight per cubic foot	29.91 lbs.
Percentage of moisture, average	15 per cent.
Ultimate strength—Tension; mean of 27 specimens	6,521 lbs. per square inch.
Ultimate strength—Compression longitudinal; mean of 31 specimens	4,385 lbs. per square inch.
Ultimate strength—Compression across the fiber; (reduction in height of piece, 3 per cent); 30 specimens	966 lbs. per square inch.
Ultimate strength—Compression across the fiber; (reduction in height of piece 15 per cent); 30 specimens	1,197 lbs. per square inch.
Ultimate strength--Compression across the fiber; longitudinal shear (pieces clamped to prevent splitting); mean of 8 specimens	548 lbs. per square inch.

Beams of redwood supported at the two ends, loaded at the middle, broke by compression:

Modulus of rupture, average of 9 specimens	4,955 lbs.
Coefficient (modulus) of elasticity, mean of 8 specimens	797,467 lbs.

In the above experiments, the pieces were clear, straight-grained, well air-seasoned, and dry.

Line of Future Work.—The field for studies of timber-physics in California is so extensive that it must take years to properly cover it. Not only the native trees of great commercial value, such as Redwood, Sugar Pine, Oregon Fir, and others, require study, but many of our lesser and neglected species will amply repay laborious investigation. At the two forestry stations, where careful records are kept, trees are growing which, when mature, will furnish authentic timber whose life-history is known, and these can be tested not only at Berkeley, but also at Washington. A very large number of exotic species, especially among the Acacias, Eucalypts, and other groups of semi-tropic and semi-arid districts, promise to furnish California with much-needed timber supplies, more particularly in the matter of hard woods. The skill of the forester must largely be directed by the results of careful tests made by the skilled physicist, or we may neglect the more valuable and plant the inferior species.

Notes on Life-History of Woods.—In considering the more ordinary types of strength-tests, familiar to engineers, it is noteworthy that Professor Unwin, a great authority, lays stress upon the importance of making tests only upon logs whose life-history is known in the most minute particular. Hence, too, arises the necessity of very exact and painstaking records at forestry stations, respecting every tree planted. Hence, the need of endless tests, so that the lowest, highest, and mean average strength of each species of timber can be determined under as many conditions as possible, and the proper sphere for each can be ascertained. The soft wood is as useful in its place as the hard, and the waste and loss, which arise in everyday life from ill adaptation or unfit choice of timbers, is incalculably great.

The botanist, discussing vegetable organization, notes with interest the peculiarly elongated cells parallel to the axis of the stem, and called wood fibers; a stress across the grain tends to separate them; a stress along the course of the grain tends to break them. The lateral strength of pine wood (needle-leaved, coniferous) is from one tenth to one twentieth of the longitudinal strength; the lateral strength of the timber obtained from broad-leaved trees (deciduous) ranges from one sixth to one fourth of the longitudinal strength. In exogenous stems (which, it is needless to say, furnish about all the world's timber, except bamboo and palm), the seasonal growths are denoted by distinct rings; the heart-wood and sap-wood are more or less separated, and, in some cases, medullary rays, or plates of cellular tissue, extend, like the spoke of a wheel, from the center to the bark. These medullary rays are planes of weakness in the timber. The botanical distinction between cone-bearers and broad-leaved trees (whether deciduous or evergreen) corresponds quite closely to the practical distinction between soft woods and hard woods.

Seasoning of Timber.—Timber, when felled, loses, in ordinary seasoning, from one seventh to one fifth of its weight. Kiln-dried, as for export, it often loses one third. The shrinkage is chiefly across its width, and particularly on the lines of the annual rings. Oak will shrink from one fourteenth to one tenth in width; Pine from one fortieth to one thirtieth. The time of cutting timber makes marked difference in the strength of the product. In experiments in Red Pine, by Professor Bauschinger, summer-felled timber showed a mean strength represented by 5.01; and winter-felled timber showed a mean of 3.78, a difference in favor of summer-felling of 22½ per cent. On the other hand, European Spruce timber, under similar conditions, showed a difference of 20¼ per cent in favor of *winter*-felling. Yet many lumbermen cut timber of every sort whenever they find it convenient. In another series of experiments, Red Pine tested five years after felling was 27 per cent stronger than the same log three months after felling, and Spruce was 25 per cent stronger. The highest values, however, are as often given by green as by seasoned timber, everything depending upon the species and condition of growth. One of the most thorough of European investigations extant, on the properties of timber, is contained in two papers by Professor Bauschinger in the *Mittheilungen* of the Munich laboratory, 1883 and 1887, from which these percentages are tabulated. He reduced all his experimental results to a uniform dryness, and made bending tests for a great variety of species.

Confusion of Common Names.—Botanically, many of the timber-tests made by the older European authorities are worthless. The following table is compiled to illustrate the confusion of commercial names, which, in truth, belong to the same species, and find their way into engineering manuals and encyclopedias. The variation in specific gravity and in various strengths is quite within the natural range of wood of the same species, differently grown, cut, or seasoned; and may further serve to illustrate the futility of testing any timber the life-history of which is unknown.

TABLE 1.—PINUS SYLVESTRIS OF EUROPE. (Under different names.)

Name by Which it is Locally Known.	Specific Gravity.	Weight per Cubic Foot.	Tensile Strength per Square Inch.	Crushing Weight per Cubic Inch.	Transverse Strength.
		lbs.	lbs.	lbs.	lbs.
Christiania Deal	.679	43	12,000	5,850	1,562
Red Pine	.576	36	12 000	5,400	1,200
Red Deal	.657	41	14,000	7,500	1,530
Dantzic Pine	.649	40	8,000	5,400	1,426
Memel Pine	.550	34	7,000	6,000	1,348
Riga Pine	.654	41	14,000	7,000	1,383
Dantzic Fir	.603	37	9,000	6,940	1,400
Memel Fir	.650	40	10,000	7,100	1,550
Baltic Fir	.600	37	8,500	6,500	1,375
Deal Fir	.541	33	8,100	5,000	1,140

Approximate Comparison of Strengths.—There is certainly a sense in which the broader comparisons of strength of various important woods can be approximately determined by the mathematical formulas of the engineering text-books. The following table represents such an approximation, calculated from the various tests of Laslett, Burr (Timber and Timber-Physics, Lond., 1875), Unwin (Testing of Materials of Construction, Lond., 1817 and 1867), Molesworth (Engineering Formulæ, Lond., 1888), and other available sources. The method used was to reduce all the tests made by different experiments upon a given kind of wood, to a general average, taking into account whatever difference occurred in size of sticks, distance of weight from center, or other items. The results give approximate values, which correspond in the main with more specialized and later results, but which, of course, can throw no light upon the range of variations possible in different specimens of any given species:

TABLE 2.—COMPARATIVE VALUES OF TIMBERS.

(Various Stresses approximately stated, in averages.)

	Specific Gravity.	Weight per Cubic Foot.	Tensile Strength per Square Inch.	Crushing Weight per Cubic Inch.	Transverse Strength per Square Inch.
		lbs.	lbs.	lbs.	lbs.
Pinus Lambertiana	.368	23	8,500	6,000	1,050
Pinus strobus	.385	24	9,500	6,500	1,200
Sequoia sempervirens	.420	26	8,000	5,500	900
Cedar of Lebanon	.486	30	10,000	5,800	1,150
Canada Spruce	.512	32	10,100	6,500	1,490
American Cedar	.554	35	7,000	4,500	776
Mahogany	.668	42	15,000	8,000	1,910
Ash (European)	.690	43	12,000	8,600	2,000
Beech (European)	.696	43	12,000	9,300	1,800
Oak (American Red)	.750	49	10,000	6,000	1,650
Oak (English)	.900	56	17,000	10,000	1,790
Oak (American Live, *Q. virens*)	.950	59	18,000	10,500	1,700
Ebony	1.187	74	24,000	19,000	2,100
Box	1.280	80	20,000	18,300	2,445
Lignum Vitæ	1.333	83	31,800	16,000	3,440

This table helps to illustrate, as all experiments show, that there is a law of relationship between specific gravity (weight) and the total strength of woods. This is more marked, however, in tests for "crushing weight" (compressive strength), than in cross-breaking strength-tests, for which the modulus of elasticity is a very important factor. Of course, strength, in any or all of its classifications, constitutes only one element of wood-values. The character of the cell-growth (upon which depends the beauty and much of the higher use of various species and varieties) is fully as important as coherence, elasticity, and other qualities which go to make up strength. But these relationships will appear more fully hereafter, when discussing the most recent methods of making tests of timber.

Specific Gravity (*Weight*).—It becomes possible, for purposes of broader comparison, to take specific gravity (or weight) of woods of different countries, many of which have not been as yet tested otherwise, and to use these, by comparison, to show the approximate place which various species hold in the strength-scale, as indicated by the following table:

TABLE 3.—SPECIFIC GRAVITY AND WEIGHT OF WOODS.

	Specific Gravity.	Weight per Cubic Foot.
		lbs.
Poplar (European)	.374	24
Willow (European)	.404	25
European Horse-Chestnut	.483	30
Cedar of Lebanon	.486	30
Walnut (English)	.616	38
Oak (dry English)	.625	39
Oak (green English)	1.063	66
Oak (Irish Bog)	1.046	65
Pear (cultivated)	.646	40
Cherry (wild European)	.672	42
Honey Locust (American)	.676	42
Ash (English)	.690	43
Birch (European)	.720	45
Yellow Locust (American)	.748	46
Mahogany (best)	.816	51
Box	1.280	80
Pinus ponderosa	.471	29
Pinus Jeffreyi	.520	32½
Pinus Jeffreyi (after 20 years in Comstock mines)	1.015	63½
Distilled water	1.000	62.425
Sea water	1.027	64
Clay	1.919	119
Cast-iron	7.200	450

In this table the arrangement (with the exception of the Oaks and Pines) is in order of increasing weights. In the Oak comparison (from Barlow), the specific gravity for dry wood is below the average for English Oak; the other Oak items, of course, are indicative merely of weight, not of strength.

It was desired to include the Deodar Cedar in the above table, but the only specific gravity test to be found in accessible authorities, gave weight at 82 pounds per cubic foot, considerably greater than Box Cedar, and this absurd result has been copied into several engineering tables—a curious example of ignorance. Deodar Cedar probably weighs 10 per cent more than Cedar of Lebanon; otherwise it is much the same wood, botanically and physically.

The comparisons of woods of Pinus ponderosa and P. Jeffreyi serve to illustrate the effect of altitude and a dry climate on timbers. P. Jeffreyi is practically the sub-species of P. ponderosa—the Pine of the east instead of the west slope of the Sierra. It is the tree which has furnished most of the timber used in the great Comstock mines. The specific gravity of a piece of P. Jeffreyi lumber is, therefore, tabulated which was originally cut fourteen inches square, and used in the roof of a mining drift, where fifteen or twenty years of pressure from the superimposed rocks and clays caused the result indicated.

Woods as Compared with Oak.—While studying the many and diverse experiments which have been made, during the past fifty years, upon "strength of materials," the only department of wood-physics that has hitherto received commensurate attention, the thought occurred to the writer that some standard of generally recognized historical importance should be chosen, by which to determine, approximately, the relative strength-values of different species of commercial woods. In pursuance of this plan, the best English Oak is taken as the standard: 1. This standard, as shown by the specific gravity, is very much higher than the Oak reported by Barlow, in the last table. It is, practically, the best Admiralty Oak, of the days before iron-clad fighting ships—the days of the Victory and the Temeraire; of Lord Nelson and his "hearts of oak."

The figures representing strength were first obtained as means of various experiments in breaking-strain, made by the authorities noted in the first column, and were then compared with the mean of the best accessible tests of Oak, so as to obtain the comparative strength in percentages of Oak. The breaking-test was taken, as affording the best test of general application to structures, and engineering generally. In some of the older experiments, it will be noted the specific gravity was not considered of any consequence. To some of these has been affixed, under the mark "approx.," the specific gravity from other sources. It will be understood, however, that these are only general data, whereas the other specific gravities represent the weight of the actual pieces used in the strength tests.

TABLE 4.—COMPARATIVE STENGTH OF WOODS (TRANSVERSE).

(Best English Oak as Standard.)

Authority.	Name.	Specific Gravity.	Strength.
English Dock Yards (Col. Beaufry tests)	English Oak	.921	1.00
Wertheim	Poplar (European)	.374 (approx.)	.32
U. S. Government tests	White Pine	.385 (approx.)	.38
Fincham	Scotch Pine		.39
Laslett	Cuban Cedar	.469	.41
English Dock Yards	Canada White Pine	.678	.49
Von Mueller	English Elm		.50
Wertheim	European Maple		.59
Wellington	European Sycamore		.63
Von Mueller	Kauri Pine	.613	.64
Laslett	Canada Yellow Pine		.66
Laslett	Dantzic Oak	.854	.68
Wellington	European Black Ash	.675 (approx.)	.69

TABLE 4—Continued.

Authority.	Name.	Specific Gravity.	Strength.
Wertheim	European Birch	.700 (approx.)	.71
Peak and Barralier	Riga Fir	.633	.72
Von Mueller	Pinus sylvestris (of Europe)	.541	.73
Von Mueller	Eucalyptus obliqua	.935	.74
Von Mueller	Eucalyptus amygdalina	1.045	.78
U. S. Government tests	Yellow Birch	.761	.80
Von Mueller	Acacia melanoxylon	.616	.81
Von Mueller	Eucalyptus viminalis	.954	.85
Von Mueller	Eucalyptus marginata	1.010	.86
Woolwich Arsenal	Best Beech (European)	.696	.87
Von Mueller	American White Ash	.800	.89
Laslett	American White Oak	.969	.92
Wellington	English White Ash	.690 (approx.)	.93
Von Mueller	English White Ash		.96
English Dock Yards	English White Ash	.782	.98
U. S. Government tests	American White Oak	.747 (approx.)	.94
U. S. Government tests	American Red Oak	.740 (approx.)	.96
Molesworth	American Red Oak	.850 (approx.)	1.05
Von Mueller	Eucalyptus rostrata	1.008	.97
Laslett	Pitch Pine		1.01
English Dock Yards	Pitch Pine		1.05
Peak and Barralier	Best Pitch Pine	.777	1.16
Von Mueller	Eucalyptus globulus	.952	1.07
Molesworth	Best Chestnut	.606	1.10
English Woolwich Exp.	Teak	.745	1.11
Von Mueller	Teak	.971	1.17
Molesworth	Teak	.780	1.31
Molesworth	Teak	.860	2.20
Peak and Barralier	Teak	.739	1.20
Kirk	Podocarpus totara	.559	1.12
Laslett	Greenheart of Guiana	1.141	1.16
Molesworth	Honduras Mahogany	.560	1.19
Laslett	Canada Rock Elm	.748	1.20
Von Mueller	Best American Hickory	.808	1.26
Laslett	Ironwood of Burmah	1.176	1.27
Molesworth	Ironwood of Burmah	1.150	1.75
Molesworth	Ebony	1.187	1.32
Von Mueller	Eucalyptus leucoxylon	1.061	1.47
Molesworth	Box	1.280	1.52
Molesworth	African Oak (a Teak wood)	.988	1.57
Molesworth	Satin-wood	.960	2.00
Molesworth	Lignum Vitæ	1.333	2.15

It is easy to see, in the preceding table, the relation between weight and strength, with minor exceptions. The correspondence is as invariable as could be expected, with data gathered from the older authorities, to whom the exact methods of the more recent physiographers were comparatively unknown. The noteworthy values of some of the American hard woods, and of the Australian Eucalypts; the value of the Kauri Pine of New Zealand, as compared with Pinus strobus; the surprising strength of Acacia melanoxylon, in proportion to its weight; the high grade of the best Beech; the great range of results in the case of English White Ash, Pitch Pine, Ironwood, and Teak, and, lastly, the astonishing value of Eucalyptus leucoxylon—these are suggestive points illustrated in this table.

American Woods.—Between 1878 and 1884, the methods used in obtaining timber-physics data were greatly advanced by investigations carried on under the supervision of Prof. C. S. Sargent, for the ninth volume of the Tenth United States Census. In that report, four hundred and five species of American trees are catalogued (since increased to four hundred and nineteen species), and are illustrated by extended tables upon the quality and fuel-value of the timber of these trees.

These results were obtained by tests made at the United States arsenal at Watertown, Massachusetts. The specimens were taken from the butt-cut of the tree, were free from knots and sap, unless otherwise stated, and hence represented the best wood that could be obtained from the trees tested. The specific gravity of every species was determined by several tests, and the means tabulated, from which the following interesting facts appear: The least specific gravity, .261, is shown by Ficus aurea, a large, parasitic tree of semi-tropic Florida; Yucca baccata, of San Diego, shows only .272. The lowest specific gravity of all the conifers, and, in fact, of all the real trees of America, is that of the Sequoia gigantea, .288. The Coast Redwood (*Sequoia sempervirens*) is .420; and our great Yellow Pine (*P. ponderosa*) is .471; some of the California Oaks rank high, as Q. Douglasii, being .892; but the small mountain Oaks of the Southwest, such as Quercus grisea, run to 1.000 or more. Sixteen species of the whole four hundred and five show a greater specific gravity than water. These are either from the semi-tropic Gulf region, or from the arid desert districts. The wood of the sub-species of Q. rubra, known in western Texas, is 39 per cent heavier than that of the common forms of Q. rubra on the Atlantic slope. A similar laws holds with reference to the White Oaks, the Ashes, and the Walnuts. On the other hand, in some families, as Platanus, the heaviest wood is of the Atlantic species.

According to the tables in Professor Sargent's Census Report, the five most valuable American woods, measured by volume, not by weight, for heat-giving value, *i. e.*, for fuel, are the following, in the order named:

(1) Pinus palustris (the Southern Hard Pine).
(2) Cercocarpus ledifolius (California Mahogany).
(3) Pinus serotina, of North Carolina.
(4) Carya alba (the Shell-bark Hickory).
(5) Oreodoxa regia (the Royal Palm of Florida).

The Oaks are of high value, but none of them are nearer to the top of the list than Number 12. In determining the absolute fuel-value, the carbon and hydrogen determinations were made by the ordinary processes of organic analysis, burning the wood in a current of oxygen. The timber had been dried at 100° Centigrade, so that calculations were made on dry wood. The nitrogen was not determined, but the amount of nitrogen in any dry wood is very slight. Resinous woods give about 12 per cent more heat from equal weights burned than non-resinous woods. If we bought firewood by weight, instead of by measurement, the most valuable fuels would be Pinus rigida, Pinus palustris, and Chamæcyparis Lawsoniana (the Lawson Cypress of California).

The Tenth Census tables upon the strength of American woods, to which I refer any one who may wish to pursue this subject further, include the following investigations:

(1) Specific gravity, ash, and weight per cubic foot of kiln-dried specimens.
(2) Behavior of woods under transverse strain.
(3) Behavior of woods under compression.
(4) Behavior of woods under longitudinal crushing.

The following table, compiled from Professor Sargent's book, illustrates the comparative place among American woods of some important species:

TABLE 5.—AMERICAN WOODS—RELATIVE RANK AMONG 405 SPECIES.

Name.	Elasticity	Transverse Strength	Crushing Strength	Resistance to Indentation	Notes.
Quercus virens (Live Oak)	49	54	59	30	The famous ship-building oak.
Quercus Douglasii	197	57	53	17	Notice failure in elasticity.
Quercus Chrysolepsis	33	4	62	32	A much-neglected California Oak.
Pinus strobus	154	225	212	278	Atlantic species.
Pinus Lambertiana	187	238	262	270	California species.
Abies nobilis	21	105	141	205	California.
Larix occidentalis	1	7	14	137	The Tamarack of Wash. and Oregon.
Robinia pseudacacia	19	3	12	71	The Yellow Locust.
Prosopis pubescens	172	91	18	28	Screw-pod Mesquite.
Cornus Florida	176	85	69	40	
Cornus Nuttalli	85	60	22	77	California species.
Canella alba	56	50	6	5	Florida.
Arbutus Menziesii	164	81	89	110	
Rhizophora Mangle	2	10	2	8	Florida Mangrove.
Carya alba	12	11	27	60	
Maclura aurantiaca	114	25	4	22	Osage Orange.

Such a table is purely arbitrary, and conditioned upon the number of species studied. The scale, as noted, is 405, and it grades from 1 down.

According to these tests, the most elastic of American woods is the Pacific Coast Larch, or Oregon Tamarack. Though not included in the table, the American wood that offers the greatest resistance to indentation is that of Guaiacum sanctum, a small, crooked, Florida tree, the American Lignum vitæ. The wood showing the greatest resistance to longitudinal crushing is that of Eugenia buxifolia, a small Floridian and West Indian tree. Carya myristicaformis (the Nutmeg Hickory of Arkansas) ranks first in transverse strength.

These Government tests confirm the principle that the transverse strength of woods is closely, but not exactly, related to their specific gravity. In six tests made with different specimens of Magnolia acuminata, the relation of strength to specific gravity was as follows: 1–1, 2–2, 3–3, 4–5, 5–4, and 6–6. In seven tests of Yellow Locust, the relation stood, 1–1, 2–2, 3–5, 4–3, 5–4, 6–6, and 7–7. Larix occidentalis, six tests, showed as follows: 1–3, 2–4, 3–1, 4–2, 5–5, and 6–6.

The largest amount of tannin in the barks of various American trees, so far as determined in these experiments, are as noted:

	Per Cent.
Rhizophora Mangle, of Florida	31.04
Picea Englemanni (White Spruce)	12.60 to 20.36
Quercus densiflora (California Tan-bark Oak)	16.46
Tsuga Canadensis (Hemlock)	13.11
Quercus virens	10.46

These figures show the amount of tannin, but cannot wholly decide the real working value, which depends upon other elements as well as the tannin.

History of the Science of Timber-Physics.—We now come to the epoch-making periods of the science of timber-physics. That science began with Duhamel DuMonceau, whose work, published in 1780, marked the divergence from purely mechanical treatment of the subject. In 1848, Chevandier, a forester, and Wertheim, a technologist, published the results of studies of hundreds of wood specimens grown in the Vosges Mountains. Their methods fairly established the fundamental principles of timber-physics. Next came the work of Bauschinger (Munich), between 1881 and 1887, and of the Royal Technical Experiment Station of Berlin (1884–1889). Meanwhile, a group of great botanists and foresters, such as Nordlinger, Weisner, Moeller, Hartig, Sachs, and others, were publishing the results of extended researches into the various properties of timber. Another distinct advance along these lines was begun about 1886 by the Forestry Division of the U. S. Department of Agriculture, under the authority of Prof. B. F. Fernow, who began, about 1886, to devise a systematic plan of this department of forestry science (Timber-Physics, Washington, 1892).

Unlike forest-biology, which relates to the living forest; unlike forest-botany, which classifies trees into species, families, and orders, timber-physics, in its later development, relates to all phenomena in the dead material of forest products, hence to the sources of those phenomena. All branches of natural science are so closely related that no arbitrary lines of division can be drawn, indicating the limits of a field of inquiry. Those limits must vary from time to time, and according to the point of view of the student. The present point of view, for the purposes of this investigation, is that of the educated forester. Two lines of inquiry are manifest: (*a*) that which depends chiefly upon botany, molecular physics, and chemistry, dealing, as it were, with the nature, appearance, and condition of the wood; (*b*) that which depends chiefly upon dynamics, dealing in effect with external forces, and the behavior of wood under such conditions. Correlate these two lines of inquiry, and we have the philosophy of timber-physics, which designs to furnish knowledge of every application of wood in the arts, and, by reasoning from cause to effect, to teach the forester how to obtain the desired qualities. Thus classified, timber-physics becomes the *central science of forestry.*

The following abbreviated schedule of the science is condensed and arranged from various Forestry Bureau reports, principally from Professor Fernow's masterly work:

SCIENCE OF WOOD, OR TIMBER-PHYSICS.

A Branch of Applied Natural Science. Arranged in Six Divisions.

(1) WOOD-STRUCTURE (XYLOTOMY).
  (a) *Outward Form.*—Bole, branches, twigs, collar, roots, bark; material furnished by each, etc.
  (b) *Interior.*—Arrangement of tissues in different parts, medullary rays, vessels, fibro-vascular bundles, as seen in various sections, the annual rings, spring, summer, and autumn growths, etc.
  (c) *Minute Histology.*—Microscopic examination into cells, tissues, etc.
  (d) *Wood-Growth.*—Studies of its laws; factors in structural formation of growing wood, etc.
  (e) *Abnormal Formations.*—Their causes and nature; burls, curly maple, wave redwood, etc.
  (f) *Disease.*—Changes in structure due to various diseases, fungoid or otherwise.
  (g) *Bark and Roots.*—Structural features, etc.
  (h) *Classification of Woods.*—According to their structure, based on above studies.

(2) Physical Properties.
- (a) *Exterior.*—Color, grain, luster, texture, transparency, touch impressions, odor, resonance, volume, etc.
- (b) *Material Condition.*—Weight, water-content, change by shrinkage or swelling, warping, etc.
- (c) *Physico-technic.*—The application of woods to the arts, as determined by physical properties of every kind.

(3) Chemical.
- (a) *Chemical Analysis*, qualitative and quantitative, of different woods, of different parts of the same tree, etc.
- (b) *Application of General Chemistry.*—Investigations into wood-changes, due to age, growth, soil, climate, treatment, or physiological processes of any sort due to external or internal causes.
- (c) *Carbohydrates.*—Cellulose, lignin, etc.; changes in organic contents; whatever illustrates fuel-value, charcoal-making; possible food-values; paper and pulp uses, etc.
- (d) *Extractions.*—Tannoids, acids, alcohol, tar, gas, turpentine, resins, essential oils, perfumes, medicinal agents, etc., such as abietine, coniferin, liriodendrin, guaiac, ilicin, saponin, various alkaloids, cathartics, etc.
- (e) *Antiseptic Principles.*—Those chemical investigations which underlie methods of increasing the durability of woods.
- (f) *Mineral.*—Potash products; relation of wood-growth to soil, minerals, etc.

(4) Mechanical.
- (a) Studies of elasticity, flexibility, toughness, and whatever, while changing form, does not destroy the tissue.
- (b) Studies of strength, hardness, cleavability, and whatever destroys the tissue while changing form, *i. e.*, the extreme limits (strength tried by tensile, compressive, torsional, shearing, and puncture tests).

(5) Technological.

Studies of woods in their technical uses; combinations of physical and mechanical properties.

(6) Philosophical.

The interdependence of structure, physical, chemical, and mechanical Relations of all these to conditions of previous growth. Analysis of known life-history of species and of individuals, and reasoning from results to causes, and from causes to results.

In the preparation of this paper on Timber-Physics, reference has been had to the following admirable works, and many others in the same field, so far as accessible in California libraries:

Manual of Forestry. W. Schlich. 3 vols. London, 1895.

Timber-Physics (American). B. E. Fernow. Washington, 1892.

Timber and Timber Trees. Thos. Laslett. London, 1875.

Materials of Engineering. Thurston. 1882.

Tables in Tenth U. S. Census, Ninth Vol. (1884).

History of Theory of Elasticity. 2 vols. Todhunter & Pearson. Cambridge, Eng., 1886.

Testing of Materials, etc. W. C. Unwin. London, 1888.

Studies in Timber-Physics. J. Bauschinger. Munich, 1883.

U. S. Agricultural Department Reports—Forestry Division.

Technical Properties of Timber. Dr. N. Nordlinger. Wurtemberg, 1860.

Garden and Forest, bound volumes; also, London Garden, etc.

IV.

REPORTS

ON

CULTURE WORK AT THE CENTRAL EXPERIMENT STATION AND SUB-STATIONS.

CENTRAL STATION; Alameda County.

CULTURE SUB-STATIONS:

- A. *Foothill Station;* Amador County.
- B. *Southern Coast Range Station;* San Luis Obispo County.
- C. *San Joaquin Valley Station;* Tulare County.
- D. *Southern California Station;* Los Angeles County.
- E. *Forestry Stations;* Chico and Santa Monica.

SYNOPSIS OF METEOROLOGICAL OBSERVATIONS AT BERKELEY, FOR THE YEAR ENDING JUNE 30, 1893.

(University of California—Students' Observatory: Assistant Professor ARMIN O. LEUSCHNER, in charge.)

Latitude, north 37° 52′ 21.7″. Longitude, west from Greenwich, 122° 15′ 37.8″. Height of cistern of barometer above sea, 320 feet.

Compiled by FREDERICK H. SEARES, Fellow in Astronomy.

	July.		August.		September.		October.		November.		December.	
BAROMETER.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.
Mean barometer for the month		29.990		29.947		30.005		30.022		30.039		30.122
Highest barometer for the month	11th, 7 A. M.	30.144	30th, 7 A. M.	30.059	18th, 8 A. M.	30.151	17th, 8 A. M.	30.231	17th, 8 A. M.	30.314	31st, 8 A. M.	30.387
Lowest barometer for the month	2d, 2 P. M.	29.775	17th, 2 P. M.	29.816	28th, 8 P. M.	29.841	14th, 8 P. M.	29.851	30th, 8 A. M.	29.562	24th, 8 A. M.	29.600
Monthly range		0.369		0.244		0.310		0.380		0.752		0.787
Highest daily average	11th	30.119	14th	30.050	17th	30.131	17th	30.189	17th	30.269	14th	30.352
Lowest daily average	2d	29.799	18th	29.847	28th	29.856	14th	29.887	27th	29.597	23d	29.772
THERMOMETER.		Degrees.		Degrees.		Degrees.		Degrees.		Degrees.		Degrees.
Mean temperature of the month (Fahr.)		59.3		59.5		61.5		55.5		52.7		48.1
Mean temperature of the warmest day	2d	72.5	17th	69.0	25th	65.5	8th	60.0	3d	62.6	26th	58.9
Mean temperature of the coldest day	6th	55.8	22d	55.7	11th	54.4	17th	49.5	24th	41.3	10th	42.1
Maximum temperature	2d	91.9	17th	89.5	6th	78.7	26th	76.0	3d	74.1	26th	61.6
Minimum temperature	10th	49.0	4th	51.0	14th	51.0	15th	45.0	24th	38.8	10th	35.0
Monthly range		42.9		38.5		27.7		31.0		35.3		26.6
Greatest daily variation		53.1		54.6		55.1		52.2		48.1	10th	19.9
Least daily variation		69.9		69.9		67.7		66.4		62.6	30th	3.2
Mean daily range of temperature	2d	29.0	17th	36.0	6th	23.2	19th	27.0	8th	23.9		10.3
Mean lowest temperature of the month	26th	7.1	7th, 30th	6.0	21st	5.6	7th	7.0	27th	2.4		44.6
Mean highest temperature of the month		16.7		14.7		12.5		14.2		14.5		54.9
PRECIPITATION.		Inches.		Inches		Inches.		Inches.		Inches.		Inches.
Rainfall during the month		0.001		0.000		0.070		1.994		5.347		6.645
Rainfall since July 1, 1892		0.001		0.001		0.073		2.067		7.414		14.059
Rainfall during same period last year		0.440		0.440		1.175		1.370		1.770		7.995
Dew and fog during month								0.016		0.011		0.012
Dew and fog since July 1, 1892								0.016		0.027		0.039
Dew and fog during same period last year										0.010		0.010
RELATIVE HUMIDITY.		Per Cent		Per Cent.		Per Cent.		Per Cent.		Per Cent.		Per Cent.
Mean relative humidity of the month		79.6		81.6		85.9		83.1		79.6		81.1
Greatest daily variation	2d	29.0	17th	41.5	25th	15.7	25th	39.5	8th	40.7	13th	43.2
Least daily variation	3d	17.2	21st	5.4	26th	0.1	7th	0.0	5th	0.6	28th	0.0
Maximum humidity	26th, 9 P. M.	94.6	*	94.0	18th, 8 P. M.	93.7	24th, 8 P. M.	95.2	25th, 8 P. M.	94.8	28th, 8 A. M.	97.8
Minimum humidity	2d, 2 P. M.	46.0	17th, 2 P. M.	46.5	25th, 8 P. M.	65.0	11th, 8 P. M.	42.8	8th, 8 P. M.	41.3	13th, 8 P. M.	44.8
Monthly range		48.6		47.5		28.7		52.4		53.5		53.0
WEATHER.												
Number of clear days		14		11		7		12		15		13
Number of fair days		1		5		15		9		6		6
Number of cloudy days				15		8		10		9		11
Number of foggy days		16		3		2		1		5		3
Number of days on which rain fell		1				3		3		7		11
WIND OBSERVATIONS.												
Direction of prevailing wind	Southwest		Southwest & West		West		West and North		North and South		North	

	January.		February.		March.		April.		May.		June.		For the Year Ending June 30, 1893.	
BAROMETER.		Inches.		Inches.		Inches.		Inches.		Inches		Inches.		Inches.
Mean barometer for the month		30.079		30.140		30.018		30.120		30.003		29.736		30.018
Highest barometer for the month	22d, 8 A. M.	30.346	11th, 8 A. M.	30.351	12th, 8 A. M.	30.422	15th, 8 A. M.	30.306	21st, 8 A. M.	30.313	22d, 8 A. M.	29.912	Mar 12th, 8 A. M.	30.422
Lowest barometer for the month	26th, 8 P. M.	29.432	4th, 8 A. M.	29.765	14th, 8 P. M.	29.650	5th, 8 P. M.	29.658	24th, 8 A. M.	29.808	3d, 8 A. M.	29.482	June 26th, 8 P. M.	29.432
Monthly range		0.914		0.586		0.772		0.648		0.505		0.403		
Highest daily average	22d	30.319	11th	30.303	12th	30.404	18th	30.278	21st	30.262	22d	29.891	Mar. 12th	30.404
Lowest daily average	26th	29.556	4th	29.848	14th	29.681	6th	29.775	24th	29.810	3d	29.511	June 3d	29.511
THERMOMETER.		Degrees.		Degrees.		Degrees.		Degrees.		Degrees.		Degrees.		Degrees.
Mean temperature of the month (Fahr.)		44.2		44.8		48.0		50.3		55.9		58.8		53.2
Mean temperature of the warmest day	15th	50.7	24th	51.1	28th	58.2	21st	54.4	24th	62.5	3d	69.5		
Mean temperature of the coldest day	31st	38.2	1st	39.0	12th	41.3	6th	45.0	29th	51.7	9th	53.2		
Maximum temperature	1st	57.3	24th	66.3	28th	74.6	21st	68.1	6th	80.0	3d	91.0	July 2d	91.9
Minimum temperature	24th	35.0	1st	32.0	12th	36.0	6th	40.3	19th	44.0	12th, 13th, 19th	46.5	Feb. 1st	32.0
Monthly range		22.3		34.3		38.5		17.8		36.0		44.5		
Greatest daily variation	22d	17.8	19th	21.8	27th	24.5	30th	24.4	6th	29.6	3d	37.0		
Least daily variation	15th	6.0	8th	5.7	18th	5.3	22d	4.2	20th	10.4	5th	13.5		
Mean daily range of temperature		13.0		13.1		12.5		15.6		22.3		21.7		
Mean lowest temperature of the month		40.3		41.8		44.3		44.3		44.8		50.1		
Mean highest temperature of the month		53.3		54.9		56.8		59.9		67.1		71.8		
PRECIPITATION.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.
Rainfall during the month		3.900		3.277		6.191		1.615		0.265		0.000		
Rainfall since July 1, 1892		17.959		21.236		27.427		29.042		29.307		29.307		29.307
Rainfall during same period last year		10.340		14.535		18.130		19.815		22.785		22.785		22.785
Dew and fog during month		0.010		0.025		0.020		0.006		0.007		0.000		
Dew and fog since July 1, 1892		0.049		0.074		0.094		0.100		0.107		0.107		0.107
Dew and fog during same period last year		0.010		0.020		0.025		0.025		0.025		0.025		0.025
RELATIVE HUMIDITY.		Per Cent.		Per Cent.		Per Cent.		Per Cent.		Per Cent.		Per Cent.		
Mean relative humidity of the month		86.8		82.0		86.5		82.6		81.1		73.9		
Greatest daily variation	11th	21.0	6th	13.2	28th	35.6	13th	20.0	24th	47.6	12th	14.5		
Least daily variation	28th	0.0	9th, 26th	0.0	23d	0.6	4th	0.0	8th, 28th	0.0	2d, 17th, 24th	0.0		
Maximum humidity	30th, 8 A. M.	97.0	8th, 8 A. M.; 11th, 8 P. M.	94.6	19th, 8 P. M.	97.0	21st, 8 P. M.	94.0	14th, 8 A. M.	92.8	10th, 8 P. M.	89.0		
Minimum humidity	19th, 8 P. M.	71.1	14th, 8 P. M.	64.0	28th, 8 P. M.	51.2	13th, 8 P. M.	66.0	24th, 8 P. M.	42.0	12th, 8 A. M.	61.5		
Monthly range		25.9		30.6		45.8		28.0		50.8		27.5		
WEATHER.														
Number of clear days		18		14		6		14		15		19		158
Number of fair days		3		7		9		4		9		5		79
Number of cloudy days		10		6		16		12		7		6		
Number of foggy days		2		3		3		1		6		5		50
Number of days on which rain fell		7		8		19		7		4		0		70
WIND OBSERVATIONS.														
Direction of prevailing wind	North		North		South		West		West		South			

* 2d, 27th, 28th, 30th, 31st, at 7 A. M., and 22d at 9 P. M.

SYNOPSIS OF METEOROLOGICAL OBSERVATIONS AT BERKELEY, FOR THE YEAR ENDING JUNE 30, 1894.

(University of California—Students' Observatory: Assistant Professor ARMIN O. LEUSCHNER, in charge.)

Latitude, north 37° 52′ 21.7″. Longitude, west from Greenwich, 122° 15′ 37.8″. Height of cistern of barometer above sea, 320 feet.

Compiled by FREDERICK H. SEARES, Fellow in Astronomy.

	July.		August.		September.		October.		November.		December.		January.		February.		March.		April.		May.		June.		For Year Ending June 30, 1894.	
BAROMETER.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.
Mean barometer for the month		29.691		29.674		29.945		30.067		30.153		30.183		30.174		30.170		30.113		30.008		29.956		30.007		30.019
Highest barometer for the month	10th, 8 A. M.	29.798	30th, 8 A. M.	29.786	20th, 8 A. M.	30.071	25th, 8 A. M.	30.294	12th, 8 A. M.	30.342	28th, 8 A. M.	30.440	19th, 8 A. M.	30.395	14th, 8 A. M.	30.411	6th, 8 A. M.	30.331	2d, 8 A. M.	30.333	15th, 8 P. M.	30.171	8th, 8 A. M.	30.173	Dec. 28th, 8 A. M.	30.340
Lowest barometer for the month	19th, 8 P. M.	29.578	4th, 8 P. M.	29.558	17th, 8 P. M.	29.782	22d, 8 A. M.	29.759	16th, 8 P. M.	29.887	26th, 8 A. M.	29.761	3d, 8 P. M.	29.915	12th, 8 P. M.	29.682	1st, 8 P. M.	29.726	20th, 8 P. M.	29.905	30th, 8 P. M.	29.714	30th, 8 P. M.	29.904	Aug. 4th, 8 P. M.	29.558
Monthly range		0.220		0.228		0.289		0.535		0.455		0.679		0.480		0.729		0.605		0.428		0.457		0.269		
Highest daily average	9th	29.785	30th	29.781	7th	30.045	25th	30.274		30.292	28th	30.421	6th	30.390	23d	30.372		30.313	1st	30.292	15th	30.127	8th	30.141	Dec. 28th	30.421
Lowest daily average	9th	29.585	5th	29.577	17th	29.805	22d	29.797		29.919	26th	29.798	15th	29.934	9th	29.898		29.773	20th	29.921	30th	29.749	2d	29.916	Aug. 5th	30.577
THERMOMETER.		Degrees.		Degrees.		Degrees.		Degrees.		Degrees.		Degrees.		Degrees.		Degrees.		Degrees.		Degrees.		Degrees.		Degrees.		Degrees.
Mean temperature of the month (Fahr.)		59.0		56.7		57.3		54.1		51.8		49.2		44.2		45.0		47.2		53.3		54.8		57.1		52.5
Mean temperature of the warmest day	11th	67.3	1st	62.1	10th	60.7	1st	61.5	14th	58.0	8th	60.4	14th	51.9	19th	50.8	28th	57.1	19th	62.9	25th	62.0	30th	63.5		
Mean temperature of the coldest day	26th	54.2	12th	53.0	20th	54.5	17th	48.8	19th	45.7	29th	38.3	6th	35.7	16th	38.4	3d	39.3	27th	45.9	15th	48.9	23d	52.6		
Maximum temperature	12th, 13th, 23d	77.0	22d	76.2	30th	73.5	13th	77.0	14th	70.5	9th	66.5	28th	59.0	24th	60.2	28th	69.3	19th	79.5	5th	75.0	30th	76.1	April 19th	79.5
Minimum temperature	16th	49.5	15th	50.5	20th, 21st	48.5	17th, 18th, 26th, 27th	45.0	20th	42.0	30th, 31st	34.5	6th	31.0	10th, 16th	31.0	3d	34.5	27th	39.5	15th	42.5	10th	46.6	Jan. 6th	31.0
Monthly range		27.5		25.7		25.0		32.0		28.5		32.0		28.0		29.2		34.8		40.0		32.5		29.5		
Greatest daily variation	5th, 23d	26.0	7th	22.2	30th	22.5	13th	24.5	13th	22.5	17th	17.8	26th	17.6	24th	17.4	23d	23.5	30th	33.0	6th	30.0	30th	23.6		
Least daily variation	28th	5.0	26th	6.4	8th	6.0	30th	6.1	30th	2.0	13th, 29th	4.7	14th	3.5	10th	2.3	5th	7.0	25th	7.8	22d	8.3	21st	6.5		
Mean daily range of temperature		18.6		15.3		14.2		14.5		11.4		11.7		10.5		11.9		14.1		19.7		16.0		15.7		
Mean lowest temperature of the month		52.4		53.0		53.1		50.1		48.6		43.7		40.8		40.7		42.7		45.8		49.0		51.6		
Mean highest temperature of the month		71.0		68.3		67.3		64.6		60.0		55.4		51.3		52.6		56.8		65.5		65.0		67.3		
PRECIPITATION.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.
Rainfall during the month		0.000		0.000		0.380		0.525		5.217		2.623		9.539		3.766		0.912		0.570		2.011		1.107		
Rainfall since July 1, 1893		29.307		0.000		0.380		0.905		6.122		8.745		18.284		22.050		22.962		23.532		25.543		26.650		26.650
Rainfall during same period last year		22.785		0.003		0.073		2.067		7.414		14.059		17.959		21.236		27.427		29.042		29.307		29.307		29.307
Dew and fog during month		0.000		0.022		0.007		0.003		0.015		0.013		0.021		0.001		0.002		0.000		0.000		0.000		
Dew and fog since July 1, 1893		0.107		0.022		0.029		0.032		0.047		0.060		0.081		0.082		0.084		0.084		0.084		0.084		0.084
Dew and fog during same period last year		0.025		0.000		0.000		0.016		0.027		0.039		0.049		0.074		0.094		0.100		0.107		0.107		0.107
RELATIVE HUMIDITY.		Per Cent.		Per Cent.		Per Cent.		Per Cent.		Per Cent.		Per Cent.		Per Cent.		Per Cent.		Per Cent.		Per Cent.		Per Cent.		Per Cent.		Per Cent.
Mean relative humidity of the month		77.9		85.5		83.3		82.3		83.5		85.4		87.9		84.2		81.6		78.5		83.0		80.8		
Greatest daily variation		18.0	2d	15.0	29th	28.0	4th	26.0	18th	26.0	15th	20.0	5th	32.0	8th	31.0	16th	50.0	12th	38.0	16th	19.0	3d	27.0		
Least daily variation	13th, 16th, 26th, 29th	0.0	4th, 10th, 25th	0.0	2d, 18th	0.0	6th, 8th, 26th	0.0	6th, 7th, 9th, 11th, 27th, 29th, 30th	0.0	1st, 19th, 28th	0.0	22d, 23d, 31st	0.0	19th	0.0	2d, 15th, 31st	1.0	3d	0.0	24th, 25th	0.0	14th	0.0		
Maximum humidity	9th, 8 A. M.	91.0	29th, 8 A. M.	94.0	10th, 8 P. M.	95.0	30th, 8 A. M.	94.0	24th, 25th, 28th, 8 A. M.	97.0	1st, 8 A. M., 1st, 21st, 8 P. M.	97.0	15th, 20th, 8 P. M., 21st, 8 A. M.	97.0	18th, 8 P. M.	97.0	16th, 8 A. M.	97.0	7th, 8 A. M.	94.0	27th, 8 A. M.	95.0	9th, 8 A. M.	93.0		97.0*
Minimum humidity	11th, 8 A. M., 12th, 8 P. M.	52.5	2d, 8 A. M.	68.0	30th, 8 P. M.	47.0	1st, 8 A. M.	47.0	17th, 8 A. M.	45.0	6th, 8 A. M.	61.0	5th, 8 P. M.	53.0	1st, 10th, 23d, 8 A. M.	60.0	16th, 27th, 8 P. M.	47.0	12th, 8 P. M.	54.0	1st, 8 P. M.	60.0	3d, 8 P. M.	52.0	Jan. 17th, 8 A. M.	45.0
Monthly range		38.5		26.0		48.0		47.0		52.0		36.0		44.0		37.0		50.0		40.0		35.0		41.0		
WEATHER.																										
Number of clear days		17		6		14		18		13		12		11		14		12		20		13		13		163
Number of fair days		11		13		10		7		4		2		6		3		9		5		9		14		93
Number of cloudy days		3		12		6		6		13		17		14		11		10		5		9		3		109
Number of foggy days		17		22		12		6		6		6		12		2		6		4		7		7		107
Number of days on which rain fell		0		0		3		3		10		11		12		11		6		2		7		3		68
WIND OBSERVATIONS.																										
Direction of prevailing wind	South		Southwest		South		West		South		East		Southeasterly		Northerly		Northerly		Northerly		Southerly		South and west			

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* November 24th, 25th, 28th, 8 A. M., December 1st, 8 A. M., 1st, 21st, 8 P. M., January 15th, 20th, 8 P. M., 21st, 8 A. M., February 18th, 8 P. M.

SYNOPSIS OF METEOROLOGICAL OBSERVATIONS AT BERKELEY, FOR THE YEAR ENDING JUNE 30, 1895.

(University of California—Students' Observatory: Assistant Professor ARMIN O. LEUSCHNER, in charge.)

Latitude, north 37° 52′ 21.7″. Longitude, west from Greenwich, 122° 15′ 37.8″. Height of cistern of barometer above sea, 320 feet.

Compiled by FREDERICK H. SEARES, Fellow in Astronomy.

	July.		August.		September.		October.		November.		December.		January.		February.		March.		April.		May.		June.		For Year Ending June 30, 1895.	
BAROMETER.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.
Mean barometer for the month		29.998		29.979		29.950		30.021		30.124		30.052		29.993		30.122		30.072		30.101		30.017		29.971		30.033
Highest barometer for the month	2d, 8 A. M.	30.150	12th, 8 A. M.	30.156	14th, 8 A. M.	30.201	27th, 8 A. M.	30.226	23d, 8 A. M.	30.251	23d, 8 A. M.	30.366	9th, 8 A. M.	30.311	16th, 8 A. M.	30.470	23d, 8 A. M.	30.303	5th, 8 A. M.	30.464	29th, 8 A. M.	30.237	16th, 8 A. M.	30.179		
Lowest barometer for the month	26th, 8 P. M.	29.878	7th, 8 P. M.	29.860	29th, 8 P. M.	29.632	17th, 8 P. M.	29.720	15th, 8 P. M.	29.918	6th, 8 P. M.	29.681	16th, 8 P. M.	29.427	8th, 8 P. M.	29.811	27th, 8 P. M.	29.722	27th, 8 P. M.	29.878	27th, 8 A. M.	29.862	7th, 8 A. M.	29.773		
Monthly range		0.272		0.296		0.569		0.506		0.333		0.685		0.884		0.659		0.581		0.576		0.375		0.406		
Highest daily average	2d	30.117		30.102	14th	30.149	27th	30.219	23d	30.250	23d	30.343	9th	30.262	16th	30.435	23d	30.259	5th	30.400		30.220	16th	30.151	Feb. 16th	30.435
Lowest daily average	27th	29.897		29.887	29th	29.682	17th	29.759	15th	29.973	5th	29.722	16th	29.432	8th	29.893	27th	29.763	27th	29.801		29.876	7th	29.797	Jan. 16th	29.432
THERMOMETER.		Degrees.		Degrees.		Degrees.		Degrees.		Degrees.		Degrees.		Degrees.		Degrees.		Degrees.		Degrees.		Degrees.		Degrees.		Degrees.
Mean temperature of the month (Fahr.)		57.7		59.1		60.3		56.0		53.7		46.6		45.1		49.6		48.9		51.0		57.2		59.3		53.8
Mean temperature of the warmest day	10th, 31st	63.3	26th	74.4	21st	72.5	4th	68.5	7th	63.8	5th	50.9	12th	53.1	19th	54.5	25th	59.8	7th, 21st	56.0	10th	71.1	18th	69.5		
Mean temperature of the coldest day	20th	53.0	15th	53.7	30th	51.5	27th	51.4	24th	50.2	24th	39.1	26th, 29th	40.3	7th	44.0	15th	41.6	4th	44.5	27th	52.7	12th	53.7		
Maximum temperature	31st	80.0	26th	93.0	22d	92.0	4th	85.8	7th	74.3	12th	57.4	12th	62.0	19th	67.0	25th	70.0	7th	72.3	11th	89.1	18th	90.0	Aug. 26th	93.0
Minimum temperature	23d	50.1	29th	47.2	28th, 29th	50.0	28th	47.0	16th, 22d, 30th	45.0	24th	37.0	24th	34.0	7th	40.1	15th	35.0	4th	39.8	21st	44.1	1st	45.0	Jan. 24th	34.0
Monthly range		29.9		45.8		42.0		38.8		29.3		20.4		28.0		26.9		35.0		32.5		45.0		45.0		
Greatest daily variation	31st	29.0	26th	27.9	7th	30.8	4th	25.3	6th	22.0	12th	15.4	12th	15.4	3d, 26th	19.0	25th	21.7	7th	25.5	11th	29.4	18th	38.0		
Least daily variation	14th	9.5	12th, 31st	10.7	29th	7.0	23d	5.3	26th	6.0	25th	3.5	16th	4.1	4th	6.0	15th	5.9	24th	6.5	1st	5.5	12th	10.4		
Mean daily range of temperature		16.8		15.6		18.5		13.0		15.5		8.5		9.8		13.2		12.7		15.4		17.7		19.9		
Mean lowest temperature of the month		52.5		55.2		55.2		52.8		49.7		43.8		41.7		45.7		45.2		47.3		51.1		52.4		
Mean highest temperature of the month		69.3		70.8		73.7		65.8		65.2		52.3		51.6		58.9		57.9		62.7		68.8		72.3		
PRECIPITATION.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.		Inches.
Rainfall during the month		0.000		0.000		1.607		3.291		1.350		12.634		10.876		3.250		2.638		2.301		1.061		0.000		
Rainfall since July 1, 1894		0.000		0.000		1.607		4.898		6.248		18.882		29.758		33.008		35.646		37.947		39.008		39.008		39.008
Rainfall during same period last year		0.000		0.000		0.380		0.905		6.122		8.745		18.284		22.050		23.532		23.532		25.543		26.650		26.650
Dew and fog during the month		0.000		0.000		0.000		0.009		0.008		0.000		0.014		0.020		0.000		0.014		0.012		0.000		
Dew and fog since July 1, 1894		0.000		0.000		0.000		0.009		0.017		0.017		0.031		0.051		0.051		0.005		0.077		0.077		0.077
Dew and fog during same period last year		0.000		0.000		0.029		0.032		0.047		0.060		0.081		0.082		0.084		0.084		0.084		0.084		0.084
RELATIVE HUMIDITY.		Per Cent.		Per Cent.		Per Cent.		Per Cent.		Per Cent.		Per Cent.		Per Cent.		Per Cent.		Per Cent.		Per Cent.		Per Cent.		Per Cent.		Per Cent.
Mean relative humidity of the month		82.6		85.7		78.2		87.6		82.8		85.6		89.5		88.2		86.0		85.8		80.6		81.0		
Greatest daily variation	10th	15.0	25th	35.0	7th	32.0	3d	20.0	12th	33.0	12th	27.0	28th	52.0	1st	18.0	3d	20.0	13th	15.0	21st	23.0	19th	16.0		
Least daily variation	1st, 5th, 9th, 15th, 26th	0.0	1st, 2d, 11th, 26th	0.0	11th	0.0	20th	0.0	19th, 20th, 26th, 29th	1.0	4th, 6th, 17th, 19th, 30th	0.0	9th, 16th, 17th	0.0	11th, 18th, 21st	0.0	4th	0.0	3d, 4th, 15th, 21st, 27th	0.0	9th, 20th, 28th	0.0	4th, 28th	0.0		
Maximum humidity	10th, 18th, 8 A. M.	94.0	31st, 8 A. M.	96.0	30th, 8 A. M.	96.0	23d, 8 A. M.	97.0	22d, 27th, 8 A. M.	94.0	15th, 18th, 31st	96.0	8th, 8 P. M.	97.0	12th, 8 A. M.	97.0	8th, 22d, 23d, 8 A. M.	95.0	27th, 8 A. M.	94.0	21st, 8 P. M.	96.0	5th, 8 P. M.	94.0	Oct. 23, Jan. 8, Feb. 12.	97.0
Minimum humidity	10th, 25th, 31st, 8 P. M.	70.0	26th, 8 A. M., 8 P. M.	48.0	21st, 8 P. M.	45.0	3d, 8 P. M.	74.0	12th, 8 P. M.	53.0	12th, 8 P. M.	36.0	28th, 8 P. M.	40.0	1st, 8 P. M.	56.0	14th, 8 A. M.	58.0	5th, 8 A. M.	65.0	10th, 8 P. M.	45.0	1st, 8 A. M.	59.0	Dec. 12th	36.0
Monthly range		24.0		48.0		51.0		23.0		41.0		40.0		57.0		41.0		37.0		29.0		51.0		35.0		
WEATHER.																										
Number of clear days		17		19		24		20		27		5		11		18		14		19		20		21		215
Number of fair days		14		8		5		7		1		8		9		4		6		4		5		5		76
Number of cloudy days		0		4		1		4		2		18		11		6		11		7		6		4		74
Total number		31		31		30		31		30		31		31		28		31		30		31		30		365
Of the total number there were:																										
Foggy days		22		21		10		9		7		1		2		3		3		0		2		15		95
Days on which rain fell		0		0		1		5		1		18		12		4		6		5		3		0		55
WIND OBSERVATIONS.																										
Direction of prevailing wind	South		South		South		Southeast		Northeast		Southeast		Southeast		Southeast		Southwest		Southwest		South		Southwest			

REPORTS ON CULTURE WORK AT THE CENTRAL EXPERIMENT STATION AND SUB-STATIONS.

CENTRAL EXPERIMENT STATION.

Berkeley, Alameda County.

GREENHOUSES AND GROUNDS OF THE CENTRAL STATION.

By E. J. Wickson, Superintendent.

The chief work of the year has been the completion of the new plant-house, of which engravings, prepared from the architect's elevation and ground plans, were given on page 341 of our Report for 1892–3. The brief description of the building and its dimensions, in view of its recent completion, may be repeated in slightly modified form, as follows:

> The plant-house was designed by Lord & Burnham, of Irvington, N. Y. The materials of the superstructure are iron and glass throughout, no wood being employed except for doors, and cap and sash bars, which come immediately in contact with the glass. The plant benches are of iron and slate of the most modern style of construction, and the hot-water heating apparatus is of a pattern approved by recent comparative tests. In these respects, the new range of houses is a model of this class of structures, and will be an example to those contemplating greenhouse building.
>
> The new plant-house is situated upon the slope between the Students' Observatory and the Botanic Garden. This location is desirable because of higher temperatures secured by elevation, and its visibleness from the main portions of the campus and the other buildings of the University. The range of buildings fronts south. The extreme length is a little more than 170 feet, and the greatest depth 87 feet. The total interior area is upwards of 7,000 square feet. The dimensions of the several portions of the range are as follows: Vestibule, 10 x 12 feet; palm-house, or central portion, 45 x 45 feet, with a clear height of dome of 42 feet; extensions on each side of palm-house, 20 x 37½ feet, 14 feet high; wings on each end of the range, 25 x 60 feet, 16 feet high. Thus the main structure consists of five apartments inter-communicating and still isolated so as to admit of the maintenance of different temperatures, as required for the different classes of plants. In the rear of the palm-house is a building 29 x 30 feet for office, potting shed, and heating furnaces. The building and its appurtenances, as covered by contract, cost $13,500.

As the construction proceeded, it became apparent that some modifications and enlargements of the rear building were desirable, and these, together with the erection of a brick chimney, were covered by a later contract for $1,350. The Regents also appropriated an additional sum of $1,000 to cover architect's fees and improvements of the site and the approaches to it. These improvements included the grading of the ground in the rear of the plant-house, to secure proper off-flow of storm-water, and the construction of terraces in front, to provide roadways upon the sloping ground. The rocks and sterile soil from the grading in the rear of the house, and from excavating the floor of the palm-house, so that a suitable depth of fertile soil could be introduced, were used in the foundations of the terraces and roads, and construction of necessary retaining walls. The sides of the terraces are to be subsequently covered with soil, the roadways properly guttered and graveled, and the surroundings of the plant-house brought into creditable form and condition. A portion of this work has already been accomplished, and it will be finished as rapidly as available funds allow. Inclusive of the additional sum of $2,350 thus expended, the total cost of the plant-house has been $16,000. In view of the size and style of the building, and the permanent character of its fittings, this must be accounted a very reasonable sum.

PLANTING IN THE NEW HOUSES.

Possession was taken of the new plant-house early in the summer of 1895, and the installation of plants therein is advancing by degrees, as material becomes available. At first the west wing was occupied mainly by a very fine collection of tuberous-rooted begonias from seed of our own raising. Ornamental and economic plants which are not sufficiently hardy for open-air culture in Berkeley are being gradually introduced. At the present time (December, 1895) about half of the space is occupied, and desirable plants are being acquired by propagation, by donation, and to a small extent by purchase, as very little money can be spared for this purpose. It is to be hoped that friends of the University who obtain rare exotics, by importation or during their foreign travel, will share these treasures with us. We are also always glad to make exchanges which will enrich our collection by new and desirable acquisitions.

PLANS AND PURPOSES.

Of course, the first attempts at occupation of the new houses do not fully disclose the system and purpose we have in view. Such attractive material as could be most quickly and readily grown has been utilized, and naturally this had less instructional significance. Such material will be displaced as rapidly as better can be grown or acquired.

There are four leading purposes in view in the provision and maintenance of this range of glass houses as a part of the equipment of the University:

First—As an essential factor in the instruction in horticulture and botany;

Second—As a necessary adjunct to the introduction, multiplication, and trial of economic plants;

Third—As affording facilities for exact experimentation in plant growth and nutrition, and in the testing of soil requirements and fertilization, under conditions which can be definitely adjusted and controlled;

Fourth—As a laboratory for study and experimentation in entomology and vegetable pathology.

Of these uses of the plant-houses it is desirable to give brief descriptions, in order that the somewhat unique character, which we propose to give to the contents of the several apartments of the structure, may be better understood.

Horticulture and Botany.—The horticultural uses of glass, in both commercial and amateur lines, have been wonderfully multiplied and extended during the last few years. Instruction in horticulture, which does not include demonstration of work under glass, is defective and antiquated. It is now, more than ever, essential that an educated horticulturist should have some acquaintance with plant-house practice, and be able to use artificial conditions when desirable. The plant-house in the horticulture of the present day is less of a museum and curiosity-shop, and more of an important supplement and annex to open-air practice, than it has ever been before. In botanical instruction, the illustrative value of living exotic forms is becoming more fully appreciated, and leading institutions of learning are securing the means of maintaining them in constantly available condition.

As the University plant-houses are to serve these primary ends, as a branch of the educational equipment of the University, it may be expected that their contents may possibly lack something of attractiveness to the casual visitor, and lack variety to the frequent beholder. It can never undertake to rival the houses of the florists, where masses of timely bloom, each in its season, are set forth in studied profusion and effectiveness. It cannot command attention for the costliness of its collections of rare varieties, as do the establishments of some wealthy amateurs. It will be held quite resolutely to its duty as a means of instruction, but its uniqueness in this respect will, we hope, commend it to the more thoughtful classes of visitors.

Economic Plants.—We have at least two ends to serve in the growth, on the University site, of exotic economic plants, viz.: to illustrate instruction in economic botany, and to provide for experiments in acclimation of economic growths. Hitherto, a collection of tender exotics has been impossible for lack of suitable glass structures. Under the very low roofs of the old wooden houses some of the most important and valuable plants could not find head room, and had to be thrown out before attaining their proper stature. With the new facilities it will be possible to accommodate quite a satisfactory collection of tropical growths, which will afford students of botany opportunity to examine many unaccustomed forms of growth and bloom, as well as to become more practically informed of their economic importance. At the same time the propagation of such plants will proceed, and systematic efforts made to discover whether any parts of the State be suited to their growth in the open air. We hope to constitute this department of the University a center of interest in this regard, receiving such accessions to its collections as generous persons may feel prompted to make, and distributing duplicates of them for wide trial by interested local experimenters, and at our own outlying stations.

Experimentation in Plant-Growth.—This has now become an essential factor in the investigation of many practical problems, notably in respect as to the ascertainment of the particular needs of certain plants, when grown in certain soils. The unsatisfactoriness of experimentation with plots in the open air, subject to all the uncertainties and vicissitudes of the season, has shown the necessity of adopting some method by which definite results can be obtained without awaiting the coöperation from averages of several years' culture-plot experiments. Such a method has, of late years, been extensively developed in Germany, and the definiteness of the results, and the rapidity with which they can be obtained, have led to its wide adoption in the European

Experiment Stations. The soils to be tested for their adaptation to the culture of certain plants, and the corresponding manurial requirements, are placed in metallic cylinders containing about twelve pounds of dry soil, and of sufficient depth for normal root development. These vessels are then maintained in a closed house at the temperature and moisture-condition known to be most favorable to the growth under trial. The plant thus develops very rapidly, and can readily be subjected to the influence of any fertilizer or other agent desired; each experiment being checked by the use of at least two vessels, checking each other. We can thus, within a few weeks, or at most a few months, ascertain what fertilizer, if any, can be most profitably used in the production of a given crop.

Many important results have already been reached by this method, not the least among which is the positive proof, obtained by the Halle Experiment Station, that bonemeal, heretofore considered as one of the best sources of phosphoric acid in field cultures, acts almost alone by its content of nitrogen, and must cease to be considered as a paying investment where phosphoric acid is required. We have thus obtained an explanation of the extremely contradictory results and opinions that have, in the past, prevailed among agriculturists, but which has, nevertheless, allowed bonemeal to remain one of the most popular and frequently used fertilizers. What, to the practical man, has seemed to be absolute proof of the value of this material, has thus been conclusively shown to be based upon an erroneous interpretation of observed facts. The method will also serve to determine, within a short space of time, the correctness of the interpretation placed upon chemical soil-analysis.

Entomology and Plant Diseases.—The plant-houses already have shown their usefulness for experimentation in these lines. While a greater amount of work in these lines can be done out of doors, than in a less uniform climate, much of the most important work requires that the conditions of heat and moisture be under better control than is possible outside the house. All the Stations doing the better class of the work are now equipped with insectaries and plant-houses. The plant-houses here, while not particularly designed for this work, are still well adapted for it.

One important line of study to which we hope to pay particular attention in the future, the acclimation of insects, could not have been undertaken with any great degree of success without some such means of control of conditions. The great number of insects imported by the State, and the very small number that became acclimated, emphasize this fact. The mere possession of plant-houses will not insure success along this line, for it may be that special houses will have to be built, which will afford means of sterilization and isolation as a defense against disease, which appears at present to be the chief difficulty met with not only in the warm, but also in the cold rooms.

IMPROVEMENT OF THE GREENHOUSE SITE.

All the labor which could be spared, during the last year, from other pressing duties for the maintenance of the agricultural grounds, has been devoted to the improvement of the site and immediate surroundings of the new plant-house. To secure the elevation desirable for considerations of temperature and protection from winds, a side hill with shallow soil and much underlying rock had to be selected. The excavation of the rock, to secure suitable depth of soil for the palm house, and to make access to the furnace room and potting rooms in the rear, required much time. The debris was used in low retaining walls, and in the foundation for the terracing necessary to provide suitable driveways in front of the building. It has been impossible, with the funds available, to secure completion of this work; but the chief part of the roughing-out has been done, the sub-drains have been deeply laid, and the site is approximately ready for the finish of good soil for the terraces, and gravel for the roadways and walks. A beginning has been made toward securing verdure upon the terraces, by planting English ivy, which roots readily and thrives with little water. As rapidly as possible the work will be completed along the zone between the plant-house and the Botanic Garden. The final adjustment of the rocky bank behind the house will be undertaken afterward, as means become available.

The movement of the best of the plants from the old houses to the new has been accomplished. The deep excavations of rock from the central area of the palm house have been filled with good soil, and good specimens of tender palms and other plants have been planted. Propagation of other typical exotic growths, mainly those of economic importance, is now in progress, and the new houses are fast assuming a condition fit to command the interest of the visitor, and to serve the instructional ends to which allusion has been made.

Propagation of plants, for trial at the outlying stations and for distribution to voluntary experimenters, has been undertaken on a scale hitherto impossible, and for which the new houses afford both space and suitable heating facilities. Large collections of seeds and plants have been secured—mainly by donation and exchange—and this feature of our work is fast assuming a more respectable and progressive character than it has hitherto possessed.

THE AGRICULTURAL GROUNDS, GARDEN, AND ORCHARDS.

In addition to the extra requirements made upon the labor force already cited, the older portions of the grounds of the Station have been well employed, and permanent plantations well maintained. Culture experiments, and open-air propagation and seed-gathering, have been pursued. A special line has been followed in the growth of a collection of tobaccos from the leading localities of the world, and curing of the leaves. This work is still in progress, and attracts wide popular interest. New cereals and forage plants are also under observation, and growth of tanning plants and textiles is continued. Upon the whole, the year has been one of the most active in the history of the Station in all lines of open-air and greenhouse work, and much credit for the amount accomplished with such moderate expenditure is due to the zeal and efficiency of Captain Emil Kellner, foreman of the Agricultural Grounds of the University.

THE BOTANICAL GARDEN OF THE UNIVERSITY.

By William A. Setchell.

The Botanical Garden of the University now occupies about seven acres of ground, of which about four have been laid out into garden plots. The remaining acres are in various degrees of preparation, but have already been planted with the different shrubs and young trees that have come into the possession of the Botanical Department.

During the autumn of last year, it was decided to take steps towards realizing a condition of things necessary in any botanical garden to be used as an adjunct of a department of instruction, and that was to bring the species of nearly related genera into close proximity, and to set aside certain definite plots for the genera of particular families, preserving the natural sequence of families as nearly as the space and conditions of soil and moisture would allow. This has necessitated two changes, which have been or are being carried out successfully, and these are: first, the laying off of smaller beds, which can be more easily worked; and second, the transplanting of a considerable number of shrubs.

The bringing together of the nearly related species of a genus and the nearly related genera of a family, increases enormously the usefulness of the garden to all who are interested in it. For the instructors and the students of the department, it is absolutely essential for the comparative study of native and foreign species. To the visiting botanist, it makes available, with the least trouble, the information which he seeks; and for the ordinary visitor it opens up, at a glance, many of the most interesting points to be obtained from such a collection.

There is little doubt but that rectangular and fairly narrow beds are best suited for such a purpose, but as the garden was already laid out, it seemed best simply to cut up the existing large beds in such a fashion as to interfere the least with the existing symmetry. That the resulting beds, one hundred and nineteen in number, will answer the purpose very well, seems demonstrated by the experience with them thus far.

The work of labeling the species has been prevented thus far by two serious hindrances: first, by the lack of funds available for providing suitable labels; and second, by the removal or changing of such labels as have been provided, by malicious visitors. Another effort will be made, however, and it is proposed not only to label the different species and genera, but also to provide conspicuous labels for each bed, indicating the particular family occupying it. Such labels as these will certainly be a great convenience, not only to the instructors and students in the Botanical Department, but also to visiting botanists in search of information concerning our native plants.

Many of the shrubs hitherto scattered about through the garden have been removed to the slopes near North Hall, to form a regular shrubbery. Nearly related species have been kept together, and as much attention as possible has been paid to foliage effects to be obtained.

The slope to the southwest of the Mechanics Building has been reserved for a collection of low native shrubs, which have been massed together in such a manner as to imitate the chaparral scrub of their native mountains.

A collection of species representative of the different genera of the cone-bearing trees has been started, and the following genera are already provided for, viz.: *Abies*, *Agathis*, *Biota*, *Cedrus*, *Chamæcyparis*, *Cryptomeria*, *Cupressus*, *Juniperus*, *Larix*, *Picea*, *Pinus*, *Pseudotsuga*, *Retinospora*, *Salisburia*, *Sciadopitys*, *Sequoia*, *Taxus*, *Thujopsis*, and *Widdringtonia*.

Altogether there are growing in the garden about 1,500 species of plants, of which 1,000 are perennial species and well established. About 1,000 of these are Californian. Besides these, there is a collection of seeds of about 2,000 species, the greater part of them native. As the perennial species become established in their permanent homes, more and more attention will be paid to the representation of our annual plants, and the collecting of their seeds for distribution and exchange. The garden certainly should become the center and source both for the more careful study of our native forms and for the dissemination of information concerning them. The department desires to obtain seeds of our native species, especially of the rarer ones, and of noteworthy forms of our common ones, and will exchange for such the seeds of native or foreign species.

The special supervision of the garden has been placed in the hands of Mr. J. Burtt Davy, who has been appointed assistant in the department, with duties assigned to the garden. The laying-out of the work in the garden, and the supervision, consume the greater part of the attention of one man, and it is hoped that this appointment will facilitate the matter of bringing the garden into such condition that it will, in a few years, compare favorably with those of the older universities.

Appended is a report of exchanges and donations to the garden, prepared by Mr. Davy:

DONATIONS TO THE DEPARTMENT.

Seeds.—About 605 packets of seeds were received during the year 1895, as donations or by exchange; of these 109 were of California plants. The following is a list of donors:

Baker, Milo S., Watsonville, California	34 packets from Santa Barbara County.
Barr & Son, London, England	11 packets.
Blasdale, W. C., Berkeley	16 packets from Tuolumne and Mariposa Counties.
Bolton, Miss, Peralta Park, Berkeley	Several packets of seeds from Arizona, and of choice selected sweet-peas.
Dammann & Co., San Giovanni a Teduccio, Naples, Italy	71 packets.
Davy, J. Burtt, Berkeley	56 packets from Calaveras County; Antioch, Contra Costa County; Newark, Alameda County; etc.
Fox, C. J., Jr., Berkeley	1 packet from El Dorado County.
Franceschi, Dr. F., Santa Barbara	6 packets from Santa Cruz Island.
Hanbury, The Marquis, La Mortola, Italy	5 packets.
Imperial University, Tokio, Japan	29 packets.
Institut Botanique, Liége, Belgium	27 packets.
Jardin d'Acclimatation, Geneva, Switzerland	36 packets.
Jepson, Willis L., Berkeley, Cal.	20 packets from Napa and Solano Counties.
MacMahon, P., Botanic Garden, Brisbane, Queensland	28 packets.
Mueller, Sir F. von, Melbourne, Victoria	51 packets.
Orto Botanico, Florence, Italy	46 packets.
Royal Botanical Gardens, Kew	Seeds of Widdringtonia Whytei.
U. S. Department of Agriculture, Washington, D. C.	113 packets.
Weiss, Dr. F. E., Munich, Bavaria	2 packets.
Wood, J. Medley, F.L.S., Durban, Natal	23 packets.

LIVING PLANTS.

Agricultural Department, Berkeley	Numerous choice shrubs and herbaceous plants.
Bancroft, F. W., Berkeley	2 plants from Knight's Ferry, Stanislaus County.
Bioletti, F. T., Berkeley	Plants of *Meadia patula*, from Mission San José.

Blochman, Mrs. I. K., Santa Maria	*Allium* bulbs, from San Luis Obispo County.
Dammann & Co., San Giovanni a Teduccio, Naples, Italy	180 bulbs, representing 35 species.
Davy, J. Burtt, Berkeley	Roots of 30 species, from Alameda, Contra Costa, and Marin Counties.
Fox, C. J., Jr., Berkeley	Bulbs of 3 species of *Allium*, from El Dorado County.
Greene, Prof. E. L., Berkeley	Annual species of Sedum, from Napa County.
Jepson, Willis L., Berkeley	Roots of 26 species, from Ithaca, N. Y.
McLaren, John, Superintendent Golden Gate Park, San Francisco	45 species of shrubs and herbaceous plants.
Pond, Mrs. Ella V., Berkeley	*Opuntia vulgaris*, and *Leptosyne maritima*.
Purdy, Carl, Ukiah, Cal.	Bulbs of 15 species of *Liliaceæ*.

THE HERBARIUM OF THE UNIVERSITY.

The herbarium of the University has been gathered by gifts and purchases around the nucleus of about a thousand species contributed by the State Geological Survey. The number of sheets now amounts to 14,108, and there is sufficient unmounted material, which is being cared for as rapidly as the facilities will permit, to bring the number up to nearly 20,000. About two thirds of these are given up to North American species. The remaining third is divided among the species of South America, Asia, Africa, Europe, and Oceanica.

The collection, while fairly representative of the flora of California, yet falls far short of completeness, and it is very desirable that this State collection should be second to none, as regards its representation of our native plants. The lack of any special appropriation makes it impossible to purchase sets of plants, and the collection is at present dependent upon the efforts of the instructors in the department, and donations from local botanists throughout the State. It is urged that the latter should contribute freely specimens of the local flora, as by so doing they will place a record of their work in a place where it is certain of permanent preservation, and of being accessible to workers on our native flora.

The Department of Botany is willing to identify plants sent to it, as far as it can, and provided the specimens are in suitable condition. For the guidance of those without experience in the preparation of plants for preservation in the herbarium, Mr. Jepson has prepared the following notes:

In order to determine the name of a species, a specimen representing the entire plant (including the roots, as well as the stem, leaves, and flowers, or fruit) should be sent, whenever possible. This is not difficult in the case of small annuals or herbaceous plants 12–15 inches high, nor even when 2–4 feet high, if more or less slender, for the plant may be folded upon itself in the shape of a V, N, or M, so that a very large plant may be made to occupy a very small space. In the case of trees and shrubs, characteristic branches will be sufficient. *All specimens should be in flower or in fruit, or with both represented*, for in many groups the species are not determinable if either is wanting. The collector should always be careful that the fruiting specimens are from the same species as the flowering ones. The stations of herbaceous plants may often be marked readily, and their fruiting specimens may be obtained later with certainty. It is always best to mark (or tag) trees and shrubs. For the University herbarium, fruiting specimens are quite as desirable as flowering ones.

Specimens should be placed between folded sheets of thin paper as soon as possible after being collected, and then dried by pressing between sheets of bibulous paper or pads, which are called "driers." Blotting paper or carpenter's sheathing paper serves this purpose excellently, but first-rate specimens may be made by using ordinary newspapers for driers. The plant, it should be remembered, remains in the thin folded sheet until the process of drying is completed; the driers, however, should be changed for fresh ones, at least once or twice a day for the first three or four days. Usually a weight of twenty pounds placed upon a board covering the top of the pile of driers suffices for pressure. For very delicate plants this is too much; for spinescent, rigidly branched shrubs, like Ceanothus or California Lilac, a greater weight will be necessary. Too great a weight should be guarded against, since the organs of the flower or other parts may be injured or destroyed by crushing.

Dried specimens for the University herbarium should never exceed 16½ inches in length and 11½ inches in breadth, since this is the size of the standard sheet of mounting paper to which the specimens are to be glued. Furthermore, a certain amount of information should accompany each specimen, in order that it may have any value for preservation. This should include, (1) the general locality (and precise station, if possible); (2) the habitat (or nature of the station); (3) the name of the collector; and (4) the date of collection. It is also very desirable that notes concerning abundance or scarcity of the plant, local or common name or names, and economic value (if any) should accompany the specimen.

Plants of the *Umbelliferæ* or Parsley family, of the summer-flowering or mountain Gilias, of the *Cruciferæ* or Mustard family (including both flowers and fruit), of the *Onagraceæ* or Evening Primrose family, and of the *Compositæ* or Sunflower family, are especially needed by the herbarium.

The Department of Botany desires to obtain specimens of *Acacia* and *Eucalyptus*, in order that a thorough revision of the species of these genera which have come into cultivation in California may be made and the correct scientific names determined. At present there is much confusion and great difficulty in determining whether the names commonly applied to these plants are those really belonging to them or not. It is very desirable, consequently, to obtain specimens both of the flowers and of the fruit of all the species grown in the State. Three or four specimens from each tree of a particular kind should be sent, numbered to correspond with the number of the tree, and the fruiting specimens to be taken from the very same tree as the flowering ones. It will also help to clear away some of the confusion if the name ordinarily applied to the tree be added to the number attached to the specimens taken from it. The name and address of the sender should accompany the specimens. Several specimens under each number are desirable, since, in many cases, the existing confusion is so great that specimens must be sent to the Australian investigators for confirmation. It is only by obtaining such a collection for comparison and study that the department can prepare itself to answer the frequent questions asked of it concerning the trees of these two genera. It is hoped, also, that a report may be issued later, in connection with the Agricultural Department, concerning these plants.

The grasses of California are very important, both from the scientific and the agricultural point of view, and Mr. Davy has supplied the following notes:

The grasses of California have been largely neglected since Dr. Thurber elaborated them for the State Geological Survey. He enumerated some 187 species and varieties as occurring in the State, and since then several new species have been described from California by Vasey, Scribner, and others, so that we have a large and important grass-flora. Notwithstanding the botanical activity in California during the last twenty years, the grasses have almost invariably been ignored by collectors, and our knowledge as regards their distribution through the State, soil, climatic conditions of growth, etc., is in a very fragmentary condition.

Many species have never been re-collected since the days of the State Survey, and but little can be determined about them without a fresh collection of specimens from the type localities.

It seems reasonable to suppose that among so many species, ranging through such varied conditions of soil and climate, a number of good fodder plants, well worthy of cultivation, might be met with.

A systematic effort should be made to obtain and identify all the grasses of the State, both native and introduced, noting carefully the habits and conditions of growth of each species. The different species could then be subjected to analysis and cultural experimentation to determine their usefulness as fodder plants.

Grasses are the plants above all others, perhaps, of which the collectors obtain the poorest specimens. They are, by no means, easy plants to determine, and it is very important that the habit of growth of each specimen should be clearly shown. By digging up grasses and washing the roots free from particles of earth, characteristic specimens may be obtained. Specimens without flowers are useless for determination, and if in fruit only, are of use chiefly as supplementing previous collections of the same thing in flower; for the whole plant—roots, stems, leaves, and flower-clusters—should be collected, if possible, when it first begins to show the powdery stamens protruding from the spikelets. Such specimens should be pressed in the same way as the ordinary flowering plants, and the labels should contain the same information.

DISTRIBUTION OF SEEDS, PLANTS, CUTTINGS, ETC.

By Edward J. Wickson.

In the last report of this Station summaries were given of the kinds and amounts of seeds, plants, and scions distributed to voluntary experimenters from the beginning of the effort in 1886 to the close of the season of 1893–94. The following is a condensed review of the work:

Ounces of Seeds Distributed, 1886–94.

Cereals	17,016
Fiber plants	2,580
Forage plants	12,887
Vegetables	7,316
Trees	2,139
Miscellaneous	2,292

Numbers of Plants and Scions, same Period.

Trees of 30 kinds	6,150
Fiber plants	1,530
Forage plants (roots)	14,770
Grapes, figs, and olives (cuttings and rooted)	18,084
Mulberries and osier willows (cuttings and rooted)	13,105
Miscellaneous	3,618

Since our last report, Bulletins Nos. 106 and 109 have been issued, giving detailed descriptions of material offered for distribution in 1894–95 and 1895–96. It is not desirable to reproduce these *in extenso*, as there is necessarily some repetition in the annual announcements. It will be better to present accounts of the plants in connection with notes from the reports received from our correspondents, and these will be found on following pages. A statistical showing of the work to the close of the season of 1894–95 is appended:

NUMBER OF PLANTS AND CUTTINGS DISTRIBUTED.

Name.	1894–95.
Forage—Jesuit's tea	43
Flat pea roots	1,820
Texas blue-grass roots	400
Grapevines—Persian (19 kinds)	1,358
Italian wine (43 kinds)	168
Olive cuttings (19 kinds)	699
Sugar cane	76
Total	4,564

WEIGHT, IN OUNCES, OF SEEDS DISTRIBUTED.

Cereals—Hackett's Australian wheat	544
Rice	272
Forage—Australian saltbush	254
Saghalin polygonum	486
Grasses—Tall oat	53
Schrader's brome	304
Japanese wheat	360
Many-flowered millet	144
Hairy-flowered paspalum	112
Garden—Melde's perennial bean	226
Irvine's hybrid perennial bean	244
New Zealand spinach	85
Zig-zag sweet corn	162
Sundry—Tree tomato of Jamaica	264
Cañaigre	192
Total	3,702

FINANCIAL STATEMENT.

	1891–92.	1892–93.	1893–94.	1894–95.
Receipts.				
Coins, stamps, orders, etc., from applicants	$170 98	$203 30	$323 63	$296 80
Assistance from Agr. Dept. of University	4 00	*92 00	12 00	41 00
Total receipts	$174 98	$295 30	$335 63	$337 80
Expenditures.				
Packing material for seeds	$6 10	$2 90	$5 00	$13 55
Packing material for plants	17 30	21 98	28 35	21 35
Postage, cartage, etc.	60 55	25 85	75 34	68 00
Stationery	4 31	9 90	6 90	4 90
Wages	61 67	*218 26	156 01	163 24
Total expense	$149 93	$278 89	$271 60	$271 04
Cash (unfilled orders) returned to applicants	25 05	16 41	64 03	66 76
	$174 98	$295 30	$335 63	$337 80

EXTENT OF DISTRIBUTION.

Number of applicants supplied	438	410	578	925
Packages sent by mail	612	517	761	1,163
Packages sent by express	46	124	56	12
Offices	267	225	329	382
Counties reached	47	46	†48	53

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*73 08 was due in 1891-92, but paid in 1892-93.

† Total number of counties in the State in 1893 was 57.

The figures of the numerical and geographical features of the distribution show clearly the growing interest in the undertaking. We desire extension of interest, and of the territory (mainly within the State of California) served by the distribution, because the data thus secured by wider local trials enable us to more accurately determine the adaptations and values of the plants which we introduce. We desire, however, to emphasize the fact that we do not maintain a *free* distribution, nor do we conduct a *seed business*, nor can we undertake to supply any seeds or plants which the applicant may desire. This is a function of the seed trade which we have no desire to assume. We always welcome suggestions of growths from those who have observed them locally or abroad, and such suggestions we are often able to turn to practical account through systematic trial, and subsequent distribution, if our results warrant it. Since the free distribution of seeds from the Department of Agriculture at Washington was discontinued, we have received many communications indicating that the writers had the idea that a similar distribution had been entrusted to us by the Government. This is not the fact. We conduct our distribution from our own resources, and in accordance with the following plan:

Distribution is undertaken for the purpose of securing a popular verdict on the value and adaptability, in all parts of the State, of the growths which we have under observation on the grounds of the Central Station at Berkeley, and of the four outlying stations in Amador, San Luis Obispo, Tulare, and Los Angeles Counties. With this purpose in view, our distribution contemplates the acceptance of an obligation by the applicant to faithfully experiment with the material supplied, and to report success or failure. That this obligation is conscientiously discharged by a large proportion of our correspondents is shown by the full data credited to such sources in our recent reports. This distribution from the Station is for the purpose of securing wide trial of growths new to the State, and does not include common trees, plants, and seeds which can be had from dealers. For this reason, we do not invite applications for general supplies of garden seeds or fruit trees. We cannot furnish them. We cannot undertake distribution to citizens of other States, except where desirable exchanges are offered.

We require the applicant to pay a small amount for each thing received, partly to bear the cost of distribution, but chiefly as a guaranty that he has not merely an idle desire for what can be had for nothing, but intends to make trial for a definite end, and will report results to us.

REPORTS FROM VOLUNTARY EXPERIMENTERS UPON PLANTS RECEIVED THROUGH THE STATION DISTRIBUTION.

By Edward J. Wickson.

We are continually gratified with the fullness and frankness which characterize the correspondence connected with the receipt and trial of material furnished by the Station to voluntary experimenters. It is not possible, in a report of this kind, to make use of all the data furnished by correspondents, but still we count it useful and valuable, and desire in every way to encourage our correspondents to give us fully the results of their observations of the behavior of the different plants, together with their conclusions as to their value or otherwise.

Most of the reports below are supplementary of earlier observation given in previous reports, and it is not necessary to repeat our own descriptions and characterizations of the plants there given. If readers of this report desire such information, they can usually obtain it by correspondence with this Station. It would be an important work to publish, in condensed form, the conclusions to be drawn from the trial

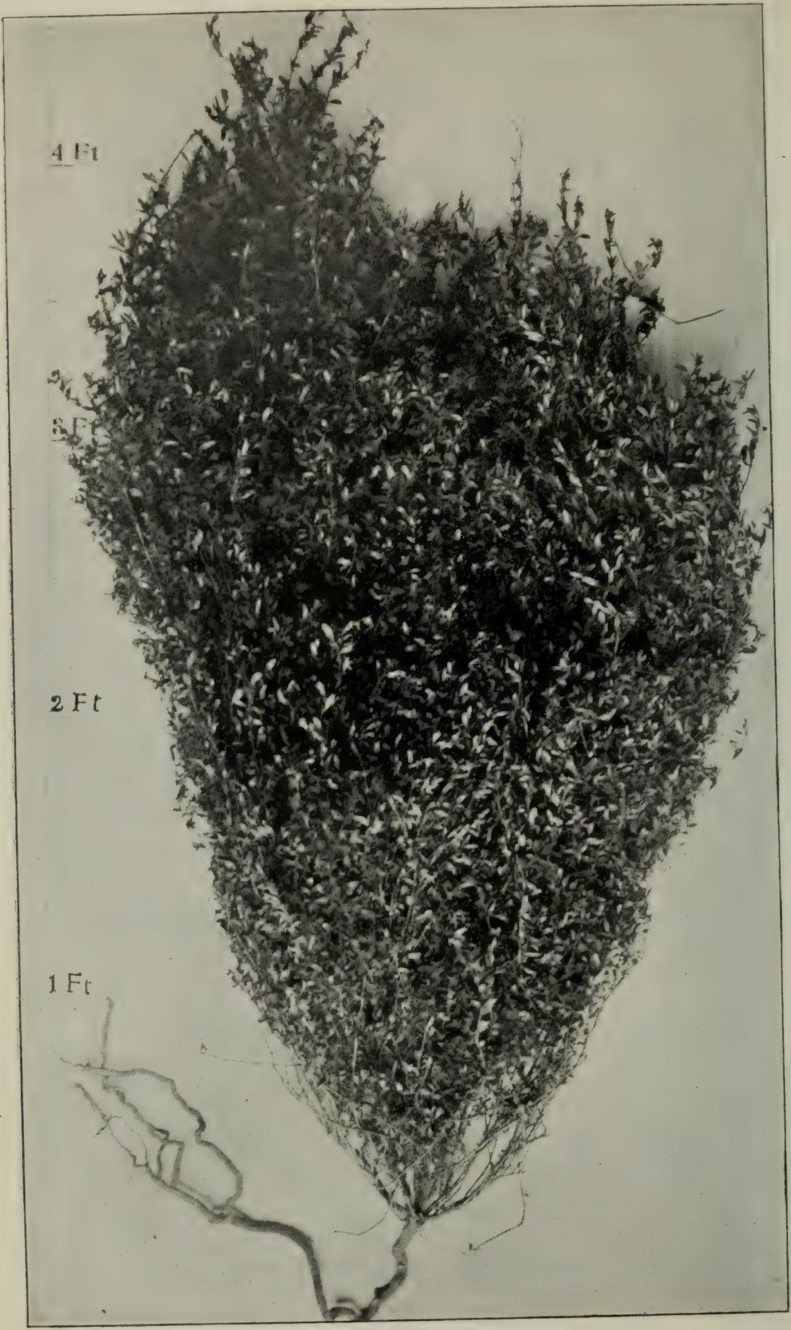

PLATE 1. AUSTRALIAN SALTBUSH (*Atriplex semibaccatum*), showing eight months' growth from one seed; foliage gathered up to show length.

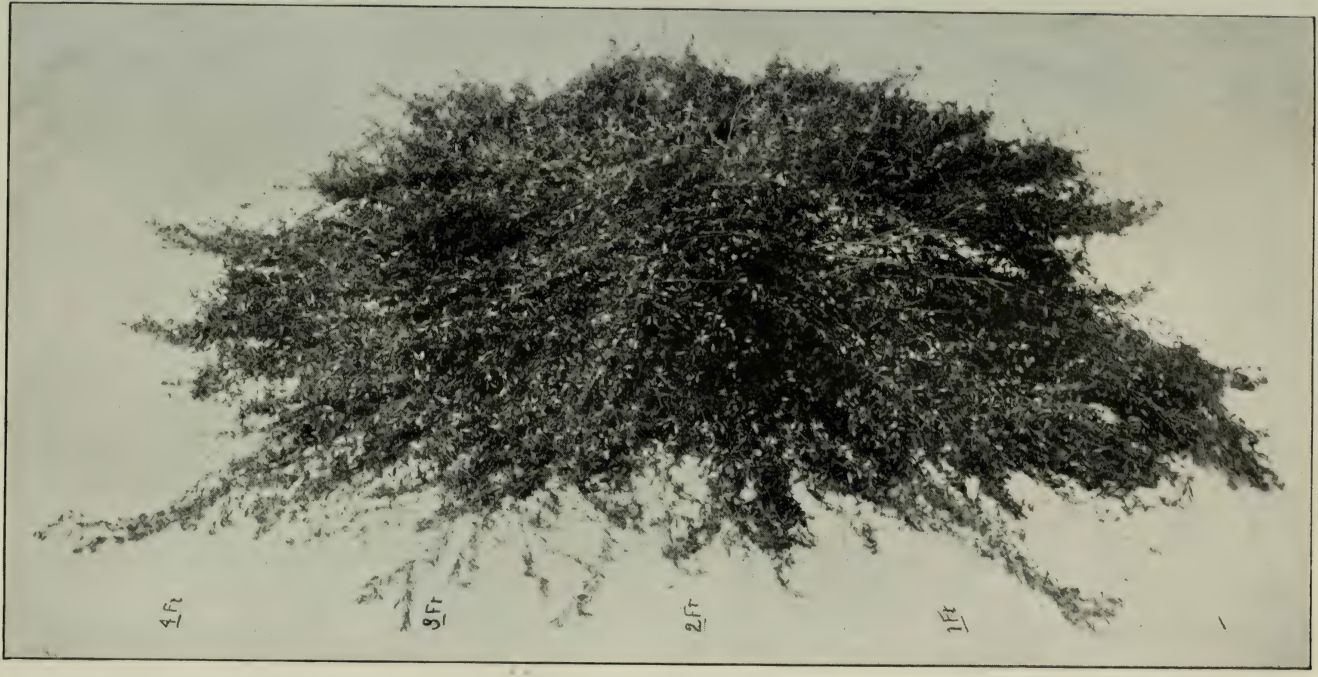

PLATE 2. SINGLE PLANT OF SALTBUSH; showing natural, circular, prostrate growth

of various plants during the series of years covered by our earlier reports, which are now out of print, and this, especially with reference to grasses and forage plants, may be undertaken if means are available for publication. At present, attention must mainly be confined to current work with very brief retrospective allusion.

FORAGE PLANTS FOR ALKALI SOILS.

The Australian Saltbush (*Atriplex semibaccatum*).—In 1880 this Station began experiments with the very interesting group of *Atriplex* species, locally known in Australia as "saltbushes," the seed having been secured through the courtesy of Baron von Mueller, Government Botanist at Melbourne. At first, special effort was made to determine the value of the plants for reclaimed salt marsh, and some indications of such value were secured; but on the whole, the species of *Atriplex* which first came to us from Australia did not show themselves to be of any marked merit. The collection was grown, however, continuously in our Garden of Economic Plants, and increased by seed of other species from Baron von Mueller, but in the Berkeley soil and climate none of them attracted attention aside from what was due to their reputation as plants of considerable economic importance at the antipodes. When special experiments were undertaken at the Tulare Station, with reference to the utilization of alkali soils, the collection of saltbushes was duplicated and planted there. One species (*Atriplex semibaccatum*) rapidly disclosed its adaptation to the local conditions, manifesting thrift in alkali spots of such intensity that no other useful growth of tree or forage plant could be maintained upon them, and producing such a weight of forage, which animals ate readily, that close inquiry into the nutritive value was pointedly suggested. The results of this inquiry were published in Bulletin No. 105 of this Station, which is reproduced upon page 165 of this report. The verdict was so clearly in favor of the plant that private distribution of the seed and of young plants was made during the winter of 1894, as far as the supplies admitted. In the hands of individuals thus supplied from Tulare Station, the plant demonstrated most gratifying success, and in December, 1894, the plant was included in our public distribution; and in Bulletin No. 106, describing that distribution, the following reference is made:

> *Atriplex semibaccatum*, which Baron von Mueller considers one of the two best of the saltbushes, has shown a wonderful growth on soil in Tulare County, which is so strongly alkaline that it will not sustain other useful growth. Small plants set in alkali spots have attained a thick, matted growth, sixteen feet in diameter, in a single season. The crop, calculated on a basis of weighing the cut from a small area, should reach twenty tons of green feed, or five tons of dry, from an acre, and probably two such cuts can be made each season. Three parts of this forage, mixed with one part of common hay, is readily eaten by horses and cattle. Sheep and hogs eat the green plant freely. As shown in detail in Bulletin No. 105 (page 166 of this report), the nutritive value of the saltbush is very satisfactory, and the importance of such a plant for alkaline soils, which have been hitherto sterile and unproductive, can hardly be overestimated. We desire to have it tried on alkali soils everywhere, in order that its climatic and other adaptations may be definitely determined. Grow the plants at first in boxes, or garden bed, covering very lightly, and plant out the seedlings several feet apart, when a few inches high, on alkali spots. This is the surest way to get the plant established, although if the seed is scattered on the surface of the alkali soil before a rain, it germinates readily when the heat is adequate. When the plant once gets a hold on the soil, it promises to set the ground very thickly from self-sown seeds, which are produced in abundance.

Our publications setting forth the nutritive value of the plant, as well as its very satisfactory growth on alkali soils, attracted the attention of those who are laboring for the amelioration and utilization of such soils, not alone in this State and country, but also in Europe, Asia, and Africa, and wide demand was made for the seed from experimenters in all the regions of the earth. Especial effort was made for a large production of seed at Tulare Station, and a considerable quantity was secured; for, fortunately, the plant seeds very generously. Private growers, convinced of the importance of the plant, also arranged to harvest a seed crop, and in December, 1895, considerable quantities were placed upon the market by private growers, and very high prices were secured—as much as $5 per pound being obtained for it in quantity. Meantime, our own supply was offered to experimenters at the cost of packing and postage, and a very wide distribution took place in the winter of 1895–96. Bulletin No. 109, issued in November, 1895, gave a restatement of the leading values of the plant, in connection with the engravings shown herewith, which show its wonderful growth in soils too alkaline to support any other useful growth.

It seems to be already demonstrated that this Australian species of *Atriplex* will constitute itself a most important industrial factor in this State, and will render productive vast tracts of land which are at present a blot upon the landscape. It will also prove of great profit and satisfaction to individual owners, whose farms are marked by alkali spots which have resisted orchard or pasture extension, and have been a loss and vexation. By means of the saltbush, these spots can be covered with verdure, and the resulting forage will aid greatly in maintaining domestic animals. The reports from this year's distribution will demonstrate the truth or falsity of these anticipations, if, indeed, the following extracts from the correspondents who received seed from the University during the winter of 1894–95 do not fully determine the value of the plant:

H. E. Brown, St. Helena, Napa County.—Australian Saltbush was planted on loam and half adobe; some plants grew to cover four feet square, some two feet square, and some just lived. My stock won't eat it.

A. Richardson, Byron, Contra Costa County.—In February I took a few of the Australian Saltbush seed and planted them in a box, like cabbage seed. On the 10th of April I planted them in some summer-fallowed land (alkali land) which was not good for wheat, but in a common year would yield half a crop. I planted Saltbush plants in a row a few feet apart, but some got drowned out by the June freshets; those which survived did well; the plants grew from one to five feet across, and yielded a considerable quantity of seed.

E. Alf. Edwards, Hollister, San Benito County.—The Saltbush did not make a very vigorous growth during the summer, but did much better when the weather grew cooler, and it bids fair to do well.

J. J. A. Connelly, Bishop, Inyo County.—The Saltbush seed came up well and made a fine growth, both in the garden and field. Some was planted on land strongly impregnated with alkali, and did as well as that set in the garden. I believe it made the best growth in rather dry soil; it seeded well, in fact, three days ago (November 23) I found some bloom, and seed in all stages; stock are very fond of it, especially cows, sheep, and poultry. Chickens prefer it to any green food, vegetables or grass; horses care but little for it. I believe it is the forage plant for thousands of acres of our alkali lands (if it is not afraid of wet feet) that will not grow alfalfa.

P. J. Richards, Bishop, Inyo County.—Saltbush has done well; planted seed in vegetable garden on April 4th; transplanted into the field on the side of open furrows or ditches, made to carry off alkali water, when irrigating; ground very alkali (black alkali). I put in 205 plants on June 4th, of which about 150 grew and did well; some plants grew to be three to four feet across, and seeded heavily. I have gathered about three pints of seed from them, and the ground under the plants is literally covered with young plants; stands a good deal of cold. Alfalfa was cut down by the frost when the Saltbush was growing and doing well. It will stand a good deal of abuse in irrigating; water has been in these ditches for three to four weeks in succession, and again has been that long without water; at the present writing, young plants are growing very vigorously; large plants are eaten down by stock pasturing in the field. Saltbush in this valley is doing well and will be a great boon, for there are hundreds of acres of alkali land, at present worthless.

H. E. Dye, Tulare, Tulare County.—Last spring, I planted in my garden a row of Saltbush, sixty feet long, plants about four feet apart; it grew to be about seven to eight feet wide. I began at one end and, as I came to each root, rolled it up like a carpet; pounded it, and got three pounds of seed; then carefully scraped up the dirt, and had fifteen pails of dirt; then a half day at the fanning mill, and I had sixteen pounds more of the seed.

Editor Traver Advocate, Tulare County.—We learn from our experience with the plant that the seed should be planted early in the fall and not covered very deep in the ground. In fact, we think seed scattered on the surface, before the winter rains begin, would give best results. We can show a plant for every seed planted, unless it be in one or two spots where they were irrigated. They do not seem to do as well when irrigated as they do on unirrigated land, and cultivation is not necessary; at least, we did not cultivate. The experiment with us was to see if it would grow on alkali—the kind of land that they say will eat off a crowbar when stuck into it—and such land that is not cultivated, but lies waste. Well, this is the kind of land on which we scratched under the few seeds we had. A look at the land about once in two weeks was all the attention it got; but that seemed to be all it needed, for the plants from the seed grew at a rapid rate. The transplanted plants did not do well, and although we watered and kept the ground loose around them, they soon died. We have great faith in this Saltbush, and truly believe that there has not as yet been any plant brought to the observation of the California farmer that will assist more in neutralizing and reclaiming alkali land than it will. Our observation shows that if planted in the fall the plants will be large enough to shade the land directly around it before the hot summer sun draws the alkali to the surface. And any one with a knowledge of such lands, knows that if the land is shaded it is always moist. This fact is what we consider the only thing that makes it possible for anything to grow on the land. This being the case, the Saltbush fills all requirements, as one single plant will send out a mat of runners four feet in every direction, and cover the ground four or five inches deep. As a forage plant we can say that we have tried it, and find that horses, cattle, hogs, and sheep eat it.

S. H. Haskell, Porterville, Tulare County.—Australian Saltbush was planted on the alkali spots; the field mice ate it as soon as it germinated. I had fourteen hills in the garden, which have done very well with an occasional watering, and have given me some seed, which I divided with some of my neighbors.

Herman S. Templeton, Porterville, Tulare County.—From the Saltbush seed sown in boxes I got lots of plants. I transplanted some of them in damp, white sand in the river-bottom; they lived all summer, but did not grow. The first cold weather killed them.

S. H. Haskell, Porterville, Tulare County.—I received a package of Saltbush seed the latter part of December, and planted the seed, as per direction, on January 3d—some on red land, some on sandy, and some on alkali land. On the 17th I went over the land, and found that most of the seed had germinated. This alkali land has never produced the least bit of vegetation in the ten years I have lived on the place.

W. A. Webster, Pylema, Kern County.—After the Saltbush plants began to run, the jackrabbits gnawed them into the ground, so that I failed to get any result.

A. B. Leckenby, Kern County Land Company's Experiment Station, Bakersfield.—Some plants and seed of Australian Saltbush were received from the Station at Tulare, and planted on different kinds of soils, ranging from "gilt-edge" to the most hopeless. It has done well in all places. I note that too much water is prejudicial to its best development, and where no water was used on moderately moist ground, the growth was best. Some individual plants covered a circumference eighteen feet in diameter. The feeding qualities, as far as observed, are very satisfactory. It is acceptable to cows, sheep, hogs, and chickens. Some horses eat it readily, while others refuse it when first offered. The seed, when sown thinly, produces plants which form a spreading mat that entirely covers the ground, and conserves the moisture in a remarkable degree. The tap-root goes straight down about four feet in our soil, and forms at that depth a mass of fibrous roots; this is not the case with transplanted plants, as the tap-root becomes demoralized and the fibrous roots form near the surface, lessening the power to withstand drought. One plant will cover about five hundred square feet, and produce about seventy thousand seeds in one season on alkali ground. We can readily see its wonderful facility to cover lots of alkali ground, and we accept it as a boon for that purpose, with thanks to the University. The plant is perennial, of neat appearance, not easily injured by tramping, grazing, or cutting; the yield is about twenty tons per acre, which loses three fourths its weight in drying. It remains green all winter, but makes its most rapid growth during hot weather; it is a sunshine plant, and does not do well if shaded by trees; it is not difficult to eradicate by one plowing, and there is no question but that it will eliminate the alkali from the ground, rendering it suitable for other crops.

Mrs. Almeda Frakes, Elizabeth Lake, Los Angeles County.—Australian Saltbush came up fine, and has done well.

William Price, Los Angeles, Los Angeles County.—The Saltbush seed you sent me last May I planted on the 28th of June. The plants grew finely and very quickly; four of the bunches I cut down early, and fed them to stock, and they ate it readily; the balance grew till the seed ripened, and then I cut them down and fed them to the stock, saving the seed, however. I have about fifty pounds of seed, which I intend to plant this year. I have about twelve acres of the worst alkali land in the country, on which not even a spear of grass will grow. I have it all plowed up, and intend to plow it up again and transplant the plants, and I think that will give it a good test. I think Saltbush will be a good thing for alkali land, as far as I have had experience with it.

R. N. Walton, Los Angeles, Los Angeles County.—I planted Saltbush on alkali and on good soil in the spring of 1895. In August the plants were three to seven feet across. Alfalfa sown at the same time is only six to eight inches high. I have grown the plants in hard black and in white sandy alkali soil. Some I watered a little, and some not at all. The result is simply grand. By thus giving us a fodder plant for waste lands you have added vastly to the productive area of the State.

R. K. McCreery, Los Angeles, Los Angeles County.—My neighbors are having grand success with Saltbush. We have sown the seed in ground that is strong with alkali, and it comes up nicely.

A. C. Bertram, Anaheim, Orange County.—Saltbush seed sown in garden-bed germinated well, and I soon had a nice lot of vigorous plants. Transplanted to alkali soil with care, soil from garden-bed adhering to roots of each plant. Notwithstanding care and apparent favorable conditions, every plant died within two weeks after transplanting. A few plants left in the garden-bed made a splendid growth, and from these I have secured seed for another trial next spring.

J. C. Young, Santa Ana, Orange County.—I planted Australian Saltbush in a bed and covered it lightly in March, put out the plants in May in a very badly-alkali place—so bad that it would not grow corn or potatoes. I set the plants four feet apart. A few of the plants died, but the most of them grew and made a rank growth, covering the ground with a mat of vines from three to six inches deep. I am pleased with the result, and am not right sure but alkali land is the best land after all. Horses and cattle eat it rather daintily at first, but will finally eat all but the coarsest part of the vine. Hogs are crazy for it; will leave corn to get it, and the chickens camp on the patch.

Mrs. John Coates, Olive, Orange County.—Horses, cows, pigs, and chickens eat the Saltbush. The army worm was bad last summer, seriously injuring the first cutting of alfalfa, but none of the Saltbushes were molested by the worms. That seems to me a little singular, as everything else ate them readily.

H. H. Gird, Fallbrook, San Diego County.—Saltbush seed came up thickly and grew with great rapidity; it promises well. It seeds heavily, and the young plants, self-sown, are coming up in great profusion. I feel sure that it will prove of value as a dry-season fodder plant.

Wm. O. Mauck, Santee, San Diego County.—I found the *Atriplex semibaccatum* satisfactory to stake out milch cows upon in summer time, when everything else is dry. My horses will only eat it dry; and as it is very hard to harvest, on account of spreading on the ground, I would rather have alfalfa in the place of it.

Observation seems to warrant the conclusion that the growth of the plant is vastly better on alkali soils than on ordinary dry soils. It is a question whether it is worth a place among dry-land forage plants. The records showing least growth are in most cases furnished by those who did not notice that we commended it alone for alkali lands, and planted it on ordinary soil. We do not yet know what rank to give it in this respect. That will be determined by the wider trials now being made.

SALTBUSH NO. 2 (*Atriplex leptocarpa*).—The notable success of *Atriplex semibaccatum* has awakened new interest in other species of the same genus. The latest received from Baron von Mueller is *Atriplex leptocarpa*, which we call "Saltbush No. 2," in lack of a better common name for it. It is native in East Australia. It is reputed to withstand much drought, to be valuable as stock feed, and to produce large quantities of seed, if not fed down too closely. We desire to have it tried in comparison with the *semibaccatum*, and for this purpose sent out several hundred rooted plants in 1895–96. It has a somewhat larger leaf, and may show other differences in feature or behavior. Later reports will determine these points.

Modiola (*Modiola decumbens*).—This plant, which is a native of Chile, has been observed growing freely on alkali lands in Kern County. How the plant was introduced is not known. In the winter of 1894–95 Mr. A. B. Leckenby, of Bakersfield, sent specimens to us for identification, with the statement that it grows luxuriantly on alkali land, without irrigation; that sheep eat it closely; that it seems as well fitted for horse feed as alfalfa, and that cows eat it in preference to alfalfa, and improve in flow of milk. Analysis of the plant in the Station laboratory (see page 146) shows that it is almost as rich in flesh-forming ingredients as alfalfa; in this respect it is superior to the saltbushes. Judging from the Kern County observations, this plant may be valuable on dry and waste places, even when strongly alkaline; but it *must be introduced with caution*, because it has a habit of rooting from its prostrate stems, and therefore will be very difficult to eradicate. In this respect it is very different from the saltbushes. In our distribution in 1895–96 we specially emphasize this possible danger in the introduction of the plant. The distribution has been very wide, including the alkali regions of Utah, Montana, and Idaho, and reports of its behavior will be awaited with interest.

DRY-LAND FORAGE PLANTS.

Sacaline (*Polygonum saghalinense*).—We adopt the American trade name of this plant, because it has been generally advertised under this term. It came to public notice as a forage plant during the summer of 1893, which was a season of exceptionally severe drought in Europe, and we secured roots for trial in California early in 1894. In our Bulletin No. 106 (December, 1894) the following sketch is given of the plant:

> A writer in the Paris *Figaro* of July 22d of that year said: "Never within the memory of living men has it been so hot, and especially so dry, as during this ill-starred year. The dreadful African heat has left not a handful of grass for the cattle, causing them to die off like flies." In several European countries recourse was had to the leaves of trees to save the cattle. In the midst of such disaster it was noticed that the *Saghalin polygonum*, a large-leafed ornamental plant, maintained its growth during the drought, and was readily eaten by the cattle. So marked was the phenomenon that the fact was brought to the attention of the Academy of Sciences, of Paris, by M. Duchartre, the statement being based upon the experience of M. Doumet Adanson at Balcine. The matter was immediately taken up by the French agricultural societies and French journals, and before the close of 1893 the fame of the plant filled the world. The French conclusion, after due investigation, was given in these words: "Had this plant been in general cultivation we should not have suffered one half the evils which have befallen us through the fearfully dry weather we have endured." So great was the demand for the plant from all the arid regions of the world that the price quoted to us by Parisian seedsmen in October, 1893, was $2 50 each for root pieces containing five or six eyes.
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> The plant which thus came to fame as a drought-resisting forage plant was discovered by a Russian explorer on the island of Saghalin, which lies in the sea of Okhotsk, between Japan and Russia. Its attractive appearance in the *Jardin d'Acclimatation* of Moscow, in 1869, led to its distribution as an ornamental foliage plant in Europe and in this country. Its industrial claims were, however, unthought of until the European drought of 1893, as described above. It already has several common names: "Siberian persicary," "Saghalin knot-weed," "Saghalin polygonum," etc. It grows to a height of eight or ten feet, with many large leaves eight or ten inches in length, and half as broad. Though it has the appearance of a shrub its stems are herbaceous. The young shoots are sometimes eaten like asparagus, and the young leaves are boiled like spinach. It is claimed that the plant will give four cuttings of forage, each of three feet high, during a summer, and would thus yield twenty-five tons per acre of green fodder at each cutting.

The plants were grown in our Economic Garden during the summer of 1894, and attracted much attention. It soon became apparent that the exaggerated descriptions of the utility of the plant had created false impressions in the public mind. We took pains to correct these, and by publication in our bulletins, and by exhibition of specimens at Farmers' Institutes and Dairymen's Conventions, insisted that the *Saghalin polygonum* is a coarse plant, and one which should not be advocated as a substitute for well-known forage plants, where the latter are satisfactory. For dry lands, scant of useful growth, the plant was commended for trial. It was shown that in good land there was a danger of its becoming a pest, because of its apparent difficulty of complete eradication. The manner of its growth with hard, woody stems, as shown in the engraving of a branch, presented herewith, relegates it to the class of browsing plants, and not to the group of succulent forage plants. When young, the shoots are succulent, and in this state would be closely eaten down by stock; but the claim that it was adapted for hay-making must be refuted, because, though the leaves are very nutritious, as shown by the analyses on page 146, the stems, when dried, are as hard and inedible as skewers. Our recommendations of the plant for trial have been restricted to its introduction to waste dry lands, where better plants cannot be grown.

The seed which was distributed by the Station in 1894–95 was imported from Japan. It germinated and grew readily with us, but in the hands of those to whom we sent it, it proved refractory, and the few seedlings which were obtained were delicate. In ordinary farm practice the roots of at least one year's growth are much hardier, and our distribution of 1895–96 was of seedling roots, grown at the Berkeley Station, from the Japanese seed. Their wide dissemination will enable us to determine the local value of the plant in later publications of the Station.

The following extracts from correspondence chiefly go to show the difficulty of securing plants from the seed and of transplanting young seedlings:

Wm. H. Hilton, Glen Ellen, Sonoma County.—Sacaline seeds were planted in a sandy sediment loam; the seeds came up, but were eaten off by the stock as fast as they appeared.

C. Hummeltenberg, Santa Clara, Santa Clara County.—Sacaline, after transplanting, grew to be a foot high, but died down in autumn. Since then the plants sprouted again, but the cold weather has cut them down again, and I do not know whether they will grow again or not. I do not think it will become a pest on our place.

H. E. Brown, St. Helena, Napa County.—I raised some fine plants of Sacaline and planted some on gravel, some on adobe, some on hard dry land, some on wet land, and some on good loam. All died.

S. H. Haskell, Portersville, Tulare County.—Sacaline plants were sunburnt pretty badly.

A. B. Leckenby, Bakersfield, Kern County.—The Polygonums are worthy of consideration as forage plants, contributing, as they do, a considerable share towards the maintenance of animal life at times and in places when and where other feed is scarce. *Polygonum aviculare*, troublesome as a weed in gardens, is decidedly valuable for pasture, and will grow on dry and alkali ground. *Polygonum muhlenbergii* is much relished by all stock, and is selected by sheep in preference to any other feed. This plant covers many acres without cultivation; is a perennial, three to five feet, erect, and furnishes feed from June to December. It will grow in swampy places or on dry land. Is easily propagated from its numerous rhizomes, but seeds sparingly, if at all. *Polygonum saghalinense* with us appears to be less valuable than the two species mentioned. Our experience is limited to one large plant received from the University. The foliage is very sensitive to frost, and it is evidently poorly adapted to our soil.

J. A. Girard, Cayucos, San Luis Obispo County.—One dozen plants of *Saghalin polygonum*, with abundance of water, now cover a space about sixteen feet square. I intend, with the seed I shall gather, to experiment on dry and waste land.

C. B. Blain, La Cañada, Los Angeles County.—*Saghalin polygonum* seed germinated very poorly, but the few plants I have, are doing nicely.

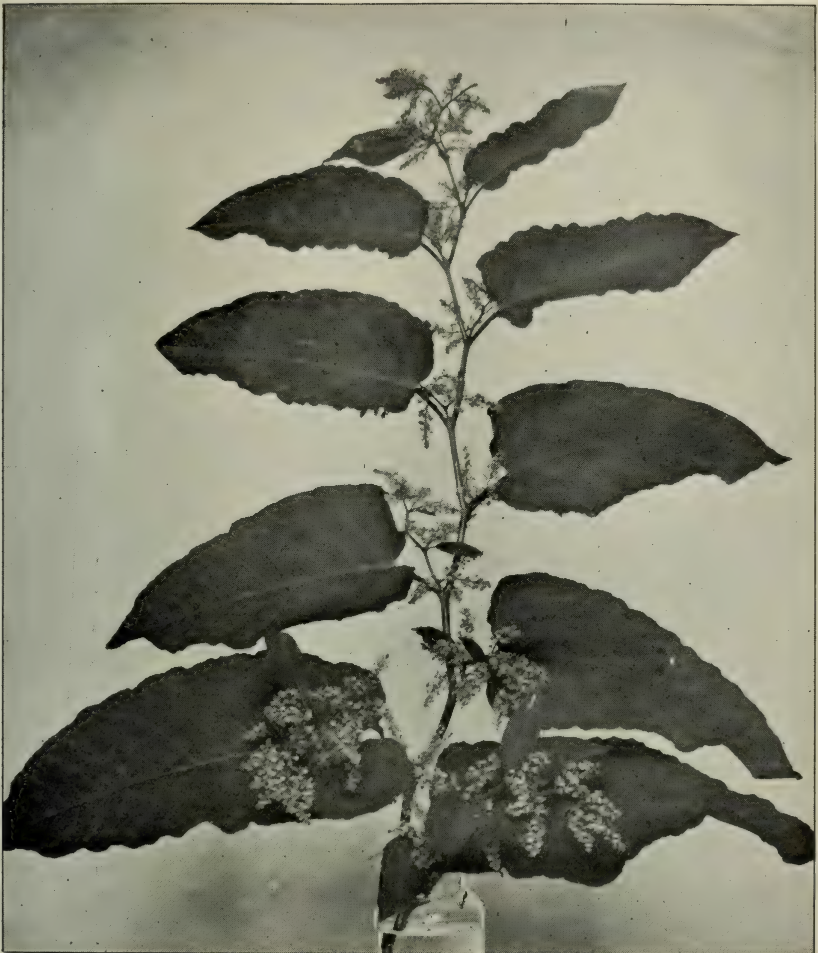


Plate 3. Branch of Saghalin Polygonum in Bloom.
(Grown at the Central Station.)

Mrs. Theresa C. Keys, Alhambra, Los Angeles County.—Sacaline seeds came up very well, better than I feared from what I had read of the difficulty in starting them. I have not transplanted them yet; fearing to do so till after the rains come, as I want to put them on the edge of the arroyo in poor, sandy soil. I am afraid to put them on better land, for fear it might be a troublesome root to get out. Think it will be fine to hold the bank when the water tears down the arroyo in the winter; also, the stock can get it.

W. L. Hall, Cerritos Ranch, Nordhoff, Ventura County.—The Sacaline seed that I got last year did not come up for me, and a few I gave a friend came up, but soon died out.

Tagasaste (*Cytisus proliferus albus*).—This handsome shrubby plant has been quite fully characterized in our earlier reports, according to our own observation of its growth and the reports of correspondents. The following notes are supplementary to the data given in our Report for 1890:

J. B. Harbers, Waddington, Humboldt County.—Tagasaste, planted the middle of May, in sandy soil, came up fairly well; a good many of the small plants disappeared; about thirty plants grew up and are now from four to six feet high. I have tried to feed the foliage to cows and horses, after feeding them hay in the barn; some would eat it, while others refused it.

Mrs. E. M. Edwards, Shasta County.—Tagasaste plants have grown very nicely; but, to my surprise, I find that nothing will eat it. I have tried to get a cow or horse, chickens or ducks to eat the leaves, but the plant will lie in the corral all day untouched. Those that had least water grew best. I would like to know if they would make good wood when grown into trees.

Robert Hastie, Clayton, Contra Costa County.—The Tagasaste did not do well on dry land; but, cared for, cultivated, and well soaked with water in July, it grew seven feet high, with long, slender limbs. From plants which I wished to transplant, I cut from one to two feet off the tops, laid them in a row along the road, and turned the cows out; they made a break for them, each took a mouthful, and dropped it without chewing, and they have never looked at it since; so it seemed to be a failure as a cattle browse. When I saw the cattle refuse to eat the prunings, I planted the plants in the pasture without any protection, with all the side branches on. Afterwards I was surprised to find that the cattle cleaned the branches up to the stems, and tried to chew them also; I have five plants left, and will plant them under protection.

H. A. Messenger, Valley Springs, Calaveras County.—I planted Tagasaste seed in the fall in different places, to see where it would do best. That on the southern side of the hill was most satisfactory. I selected a place where there had been a pile of brush burned, leaving the ground bare of other seeds, and picked the earth about six inches deep with a pick. Then I planted the seed and put a light covering of brush over them, to keep the quail from scratching them up, also as a mark and for general protection. The seed came up finely about March; but the rabbits destroyed a good many plants, and as soon as they got above the brush the cattle took them off. But they held their own pretty well, and grew about two feet high that year. From my experience I am satisfied that it is a valuable forage plant, and if my land had Tagasaste on it in place of chaparral, I feel confident I could keep three times the stock I am now able to do on the same range.

R. R. Peet, Madera, Madera County.—Tagasaste has done very well; it has been much liked by horses, cows, and pigs.

E. A. Edwards, Hollister, San Benito County.—I planted Tagasaste seed in seed-bed, and plants seemed to grow thriftily; they were transplanted to open orchard ground, but, I suppose owing to drought, they failed to grow. I transplanted another lot to light sandy land after irrigating, but they made but little growth, and but few now appear to be alive.

Mrs. C. Theresa Keys, Alhambra, Los Angeles County.—The Tagasaste I planted two years ago has grown to the height of twelve to fifteen feet; makes huge, spreading branches; I have just cut it back to three feet high; have cut it back twice before, and shall also plant it in the arroyo, where it must grow without irrigation. The stock eat the trimmings readily, and seem to like it at once. It is a very pretty plant.

J. C. Lester, Vista, San Diego County.—Tagasaste does well; I have plants eighteen inches high—the first year's growth from the seed.

These records of individual observation are in conflict upon the acceptability of the plant to stock. One correspondent strongly commending the plant for all kinds of stock, and another naively asking the possible value of it for firewood, comprise the extremes. Our own experience is in favor of both propositions. In rich soil the plant grows into a low tree and makes a stem four inches or more in diameter, which could be used for fuel in the absence of harder wood. On drier lands the plant makes a low, shrubby growth, which is readily browsed by stock when succulent grasses disappear in the summer. Animals which are fully fed do not kindly take to it, but otherwise it has demonstrated its suitability for rough pasturage.

Elliott's Sida (*Sida Elliottii*).—This malvaceous, shrubby plant was characterized in our Report for 1892–93. Further trial seems to show that it has some standing as a dry-land browsing plant, though its growth is less than could be desired. It seems to endure drought, but does not enjoy it. The following are correspondents' references to it:

Wm. E. Whitmore, Whitmore, Shasta County.—Elliott's Sida grew where irrigated, and I planted seed again last December; they germinated in June or July, and now the plants are loaded with seed. I see nothing in the plant that makes it appear desirable in this climate; though the seeds are yet hanging after several frosts.

Robert Hastie, Clayton, Contra Costa County.—Elliott's Sida is a failure with me. It is growing, but does not produce enough. It roots deep in the soil, and keeps green all summer.

H. H. Huettenberger, East Oakland, Alameda County.—Elliott's Sida is growing, but very little; the plants are only twelve inches high.

E. R. Pierson, Raymond, Madera County.—Elliott's Sida bears seed, and volunteers, and is not in the least injured by the greatest heat, though easily killed by frost. It grows about one foot high, and, as its foliage is rather scanty, it does not seem to me to be of any great value; but, considering its drought-resisting qualities, it may, with further trial, prove so.

H. H. Gird, Fallbrook, San Diego County.—Elliott's Sida is relished by stock, and too well by rabbits; they visit it persistently, and keep it gnawed to the ground. It starts vigorously from the stubs.

The "Wonderful" Cow Pea.—Continual reports of the value of "cow peas" in the Southern States, both as forage and as green-manuring plants, have induced a wide disposition among our correspondents to try them in California. In 1893 we were fortunate in receiving from D. M. Dimmick, Esq., of Carpinteria, Santa Barbara County, a supply of seed of the new cow pea "Wonderful," which was believed to be the best of its kind. It yielded a very large amount of forage and peas for Mr. Dimmick, and remained green on his land until destroyed by frost. The pods are very long, and carry as many as eighteen peas to the pod. This seed was quite widely distributed, and the following reports have been received:

G. B. Pearce, Paradise, Butte County.—Wonderful Cow Pea, planted in a four-year-old orchard, was not a success, though it did better than other things, such as beets and beans.

W. H. Mullen, Big Bend, Butte County.—Only a few seeds of the Cow Pea came up, owing to the dry month that we had last spring; and those that came up, I think the hares ate, for when I went to cut hay there was no Cow Pea.

C. Graham, Upper Lake, Lake County.—The Wonderful Cow Pea grew vigorously, but cattle did not like the vines; few peas were formed.

John Markley, Geyserville, Sonoma County.—I planted Cow Peas in a moist place; they grew well, ran about four feet, bloomed late, had only few pods on them; the vines green until frost. Horses and cows running in the field did not eat the green vines.

H. E. Brown, St. Helena, Napa County.—Wonderful Cow Pea is of no use here. It grew fourteen inches high, with strong, large stems, but no blossoms and no peas; it keeps green all the time.

Wm. Beauchamp, San José, Santa Clara County.—Cow Pea made a growth of about twelve to fifteen inches, with no sign of bloom. It is quite tender, and was killed by frost.

U. S. Adams, Raymond, Madera County.—Wonderful Cow Pea is very good, and makes quite a wonderful growth.

Frank Bentz, Soulsbyville, Tuolumne County.—Cow Pea was planted in May, after I thought all danger from frost was over, but a slight frost about the 25th killed them all.

Evans Bros., Vincent, Los Angeles County.—Wonderful Pea did not do well; it grew to a very strong vine, but the pods did not thrive; we only got one ripe pod from the whole lot.

W. H. Doty, Los Angeles, Los Angeles County.—At Claremont the Cow Peas did very well, ripening up about November 1st, but that will not do for our orchards, because they must be cultivated during the summer months. Besides, the trees must have the water during the summer.

Edwin Squire, Claremont, Los Angeles County.—The bean-shaped Cow Peas, samples of which were submitted to you for recognition, were killed by a slight frost, not severe enough to kill tomato vines. They were ten inches high at the time.

J. H. Fisher, Carlsbad, San Diego County.—Our lands are dry, somewhat sandy on the coast. The Wonderful Cow Pea survived the extreme drought, and matured a few peas, with which I shall try again this year.

Samuel C. Dondore, Flinn Valley, Lakeside, San Diego County.—The Wonderful Cow Pea made a good growth, and is still green (November 15th), and the seeds are just maturing. It did not get any water for six months. Horses and cattle will eat it when other feed is scarce.

The sensitiveness of Cow Peas to frost seems to rule them out as a crop for green-manuring, which, in California, must be grown in the winter while there is surplus moisture in the soil, and must be plowed-under early in the spring to secure decay before the soil becomes dry. As a forage plant the Cow Pea has not thus far made any satisfactory record.

THE FLAT PEA (*Lathyrus sylvestris*).—This plant was quite fully characterized, and illustrated with an engraving, in our Report for 1892–93. Since then, fuller chemical investigation of its nutritive value has been made, as set forth on page 146 of this report. Correspondence from growers to whom we supplied root-cuttings for trial now enables us to trace quite fully its local behavior in California:

Wm. E. Whitmore, Whitmore, Shasta County.—The Flat Pea, where watered, covered the ground; but three feet above the ditch all died out. The second year it bloomed, and I saved three or four pods for seed. However, I fear it requires a warmer climate, as, though a dense mat on the ground, it does not grow high enough to mow.

J. B. Harbers, Waddington, Humboldt County.—The Flat Pea was planted in sandy soil; only a few of them grew, and those died when about two inches high.

E. A. Jenks, Harris, Humboldt County.—Roots of Flat Pea planted in my orchard lived, but did not make any growth; the soil was black; beets, turnips, peas grew well near by. I think the climate does not suit the plant.

August Gossman, Christine, Mendocino County.—The Flat Pea roots planted in the garden came up and grew about three inches high; and, about July 1st, when the warm weather came, the blades began to turn white, and finally they all died.

C. Graham, Upper Lake, Lake County.—The Flat Pea roots were frozen and killed.

James Dodge, Forest Ranch, Butte County.—Flat Pea roots, sent me, were nearly a failure where I put them; the best growth is only about eight inches.

Wm. H. Hilton, Glen Ellen, Sonoma County.—Flat Pea roots were planted in vegetable garden; a few have done well, and will be transplanted this season; one root was planted in pasture, and is living.

C. A. Cary, St. Helena, Napa County.—The Flat Pea root-cuttings are still alive, but they did not make much growth, or blossom.

H. E. Brown, St. Helena, Napa County.—*Lathyrus sylvestris* continues to grow and spread. It went to seed this year, and I got half of a small teacup of seed.

T. W. Madeley, Newcastle, Placer County.—I had to come to irrigation in order to keep the *Lathyrus sylvestris* alive, and that is all I was able to do, there being very little growth this summer—maybe six or eight inches.

L. L. Guss, Brentwood, Contra Costa County.—The Flat Pea, received two years ago, does not make any headway.

H. H. Huettenberger, West Oakland, Alameda County.—The Flat Pea is very small; the vines are from six to twelve inches long.

E. F. Eastman, Gilroy, Santa Clara County.—Flat Pea roots were planted March 7th, in a gravelly loam. My experience is that the cultivation of the Flat Pea, by the ordinary farmer, will be a failure. Alfalfa succeeds well on the same ground with the same care.

C. Hummeltenberg, Santa Clara, Santa Clara County.—The Flat Pea, for some reason or other, did not do well. I saw, however, a number of plants of it out in the country where I was at work. These were much better than mine, but not of an encouraging size or appearance.

E. Alf. Edwards, Hollister, San Benito County.—But few Flat Pea plants survived the summer and those made but small growth. Were planted in common orchard soil (sandy loam), without irrigation.

R. S. Nougaret, San Ardo, Monterey County.—The Flat Pea did not do well at all.

H. E. Dye, Tulare, Tulare County.—The Flat Pea only got two to three inches high during the summer; but this fall it grew some twigs eight or ten inches. Had water, and was in very sandy loam garden.

Henry Murphy, Milo, Tulare County.—The Flat Pea planted April 10, 1894, made a growth of ten inches, and stands the drought well.

Walter McCoy, Milo, Tulare County.—The Flat Pea was planted in March, 1894, and gives promise of being a good forage plant, as it withstands drought well.

E. R. Pierson, Raymond, Madera County.—The Flat Pea does not seem to stand extreme summer heat as well as some others; but, as it is not hurt by pests, it may prove of some value, if it makes enough growth in the cooler months. It has not done so as yet, and has not blossomed.

Frank Bentz, Soulsbyville, Tuolumne County.—The Flat Pea failed to make any growth whatever, and finally died.

D. R. Brubaker, Shandon, San Luis Obispo County.—Flat Pea roots were planted in valley land, and failed entirely.

F. S. Gould, Santa Barbara, Santa Barbara County.—*Lathyrus sylvestris* has grown better this second year than last year, but has not seeded.

C. B. Blain, La Cañada, Los Angeles County.—The Flat Pea has proved a failure on dry sandy soil, even when watered moderately. It appeared to mildew.

Mrs. Theresa C. Keys, Alhambra, Los Angeles County.—The Flat Pea roots were set out in the orange grove near the water, and have done well; shall transplant them this winter.

Francis Beckwith, Altadena, Los Angeles County.—Flat Pea roots are still alive, but they did not produce anything last year. I am afraid our location is too dry for them.

Evans Bros., Vincent, Los Angeles County.—A few of the plants of the Flat Pea showed vitality when we planted them, but afterwards died out, although we gave them good care and attention.

R. S. Watt, Tejunga, Los Angeles County.—The Flat Pea was a total failure with me.

T. J. Richards, Bishop, Inyo County.—Flat Pea roots came up, grew six to eight inches high, and died; I think for want of water. I am afraid it never had the attention it deserved.

William Lester, San Bernardino, San Bernardino County.—The Flat Pea was planted in rich, moist, mallow soil. but has only grown plants about eighteen inches in diameter. Planted on average soil in South Riverside, it has made about the same growth.

J. Docking, San Diego, San Diego County.—The Flat Pea is thriving well.

Landon Bonham, Valley Center, San Diego County.—Of the Flat Pea, only two roots grew; last year it was very dry here, and the plants had no irrigation, and did not grow much. The past summer the Pea has grown very well, and has formed a fine sod. I shall spread it on more ground this winter.

S. C. Dondore, Flinn Valley, Lakeside, San Diego County.—The Flat Pea was not a success with us.

This is a pretty clear case of total failure. The plant has done better in the cool climate and heavy soil of the Berkeley Station than in any other part of the State. Evidently it cannot be depended upon to endure the California styles of heat and drought. It has failed where other species of *lathyrus* succeed in making at least a good winter growth.

Jerusalem Artichokes (*Helianthus tuberosum*).—There has been quite a wide distribution of the white and the red Brazilian varieties of Jerusalem Artichokes during the last few years. Opinions of their value vary in this State, as elsewhere, as the following reports indicate:

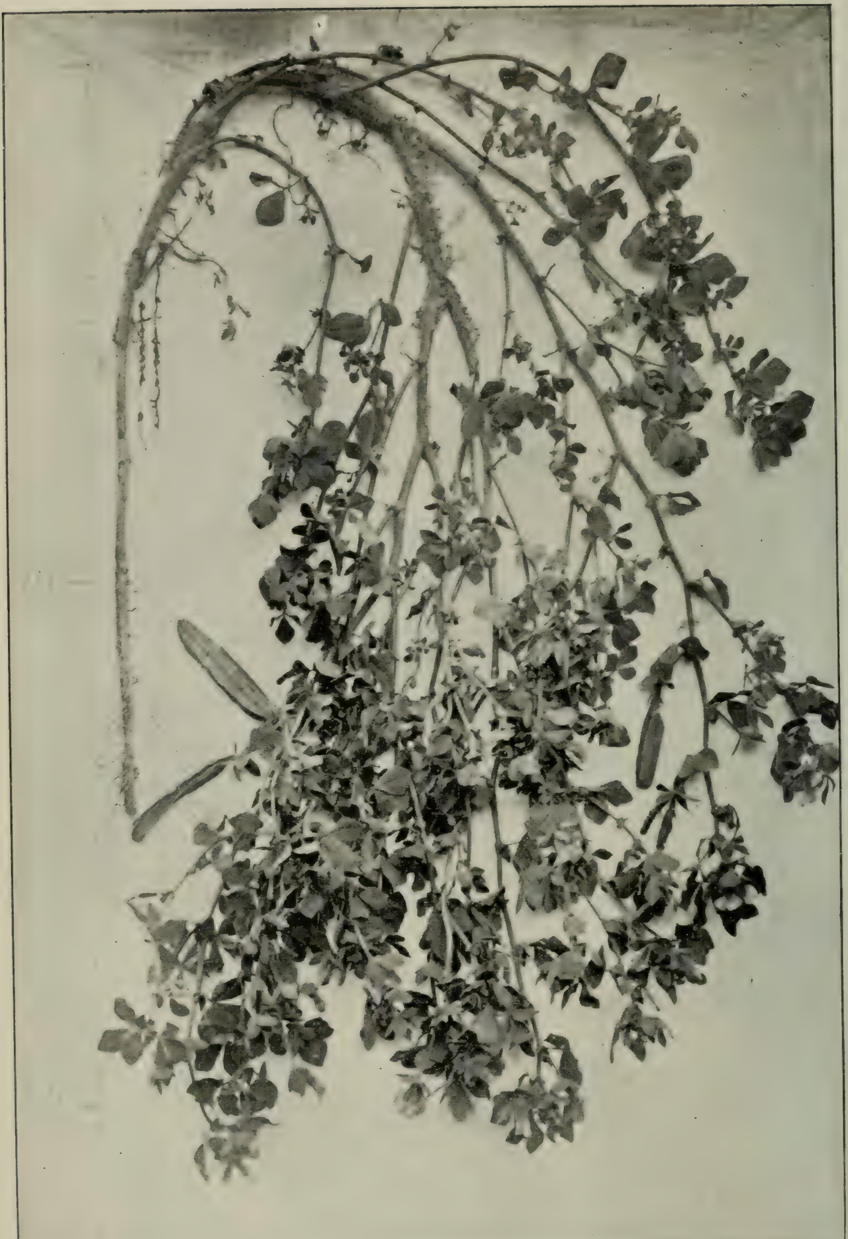


Plate 5. The Square-Pod Pea (Lotus Tetragonolobus).

E. S. Shanklin, Susanville, Lassen County.—Artichokes grew well as far as I could judge, but I cannot get hogs to touch them raw.

J. C. Hobson, Healdsburg, Sonoma County.—Jerusalem Artichokes grew very finely indeed; I think they will prove an excellent hog-feed in this part of the State, judging from the abundant yield and nutritive qualities.

J. H. Brown, Kelseyville, Lake County.—I find the Brazilian Artichokes very prolific, and wonder why they are so seldom grown. I have given tubers to a number of my neighbors.

Charles E. Butler, Palo Alto, Santa Clara County.—We have been much pleased with the two varieties of Artichokes, especially the white. They seem to grow better without too much water. From a mere handful we harvested, this fall, three sacksful.

R. S. Nougaret, San Ardo, Monterey County.—The Artichokes did fairly well, though I was obliged to irrigate them. But this year was the driest since 1877, and that may account for the partial success.

PLANTS FOR GREEN-MANURING AND FORAGE.

This Station has for years grown leguminous plants (clovers, vetches, lupins, peas, beans, etc.) with a view of finding some plant, with the power of absorbing atmospheric nitrogen, which would make a good winter growth and thus be fitted for plowing-under for green-manure while the soil retained moisture enough to promote the rapid decay of the vegetable matter thus added to it. Several plants have seemed to answer these requirements in varying degrees, but were for one or another reason unsatisfactory. During 1894 and 1895 we have been favorably impressed with two plants, which have been distributed for trial with this special end in view.

Square-Pod Pea (*Lotus tetragonolobus*).—During the winter of 1894, Director Hilgard, in examining a number of foreign legumes in our Economic Garden, found one whose roots were fairly incrusted with tubercules (see engraving, p. 120), implying a very rapid absorption of nitrogen from the air. Continued observation shows that the plant combines the advantage of quick development, being an annual with an unusually heavy production of herbage—the latter, in two different plots, having been at the rate of twenty-four and twenty-six tons per acre, equal to about five tons of air-dried hay. While its nitrogen-percentage is less than that of alfalfa or burr clover, its aggregate nitrogen-product would nevertheless be considerably greater than in the case of alfalfa, and more than twice as great as with burr clover. The plant has apparently no distinctive common name (though it has names which apply also to other species), and Director Hilgard selected the term "Square-Pod Pea"—its pod being four-sided and winged, as shown in the engraving presented herewith. It is a native of Southern Europe, where it is grown for ornament and for salad. The seed is rather large, which is unfortunate, for it increases the cost of getting a thick cover of the plant for plowing under. Local production of the seed may, however, cheapen it sufficiently. We desired, during the winter of 1894–95, to have the plant grown by many orchardists with a view to determining its winter growth in different regions, and its general suitability for a green-manure crop; also by dairymen and others, to determine its value for winter feed. It was, however, found impossible to procure any adequate supply of the seed, and the matter was postponed until a local supply could be grown on the Station grounds.

Snail Clover (*Medicago turbinata*).—While the observations upon the foregoing plant were in progress, the winter growth of Snail Clover attracted attention and suggested its adaptation for green-manuring. It was seen to be more hardy than the Square-Pod Pea, and less sensitive to drought, and made a heavier growth during the early part of the winter. Snail Clover is a native of southwestern Spain, and has shown value as a winter forage plant in this State. It is closely related to the "Burr Clover," but it has a larger seed-pod, which is smooth and more abundantly produced, and therefore the plant is superior as a dry forage plant for stock. The nutritive values of the two plants are compared on page 147 of this report. The green growth of the Snail Clover resembles that of Burr Clover, but with us it is much ranker. It starts from the seed as soon as the earth is moistened by the fall rains, and makes a strong growth during the winter and spring, drying up as soon as its vast crop of seed-pods ripens early in the summer. By sowing upon orchard ground, plowed as early as practicable in the fall, it should make a dense mat of foliage by the time of the spring plowing. It seeds so freely that by allowing a small area to go unplowed in the spring, seed enough can be secured for covering a considerable area of orchard. On the Station grounds in Berkeley we sowed twelve and one half pounds of seed on about one quarter of an acre, and secured four hundred pounds of seed-pods. The seed-pods are so large that they can be easily gathered from the surface of the ground after the plant has dried up. In its winter growth, therefore, and the ease with which the seed can be produced, the Snail Clover offers many points of promise as a green-manure plant. The accompanying engraving shows the manner of growth of the plant and the form of the seed-pod.

Crimson Clover (*Trifolium incarnatum*).—The winter growth of this plant, according to our observation and reports made to us, is not satisfactory; consequently, it does not serve for green-manuring here as well as it does in the East, where it can be plowed under in midsummer. It makes a splendid growth in most parts of California in May and June, but it is then too late for plowing-in.

Tall Oat Grass (*Arrhenatherum avenaceum*).—This grass has been commended in our reports since 1890, as one of the most satisfactory of dry-land grasses thus far introduced into California. The distribution of seed from the Station has been wide, and the latest reports from correspondents confirm the good opinions of the plant, which have been previously expressed. We cite the following:

E. A. Jenks, Harris, Humboldt County.—Tall Oat Grass grows as tall as grain, and will yield as much hay per acre, with the advantage of not having to sow it every year. The small plot that I planted with the seed you sent me gets thicker every year; the grass grows four to five feet high.

Thos. Dickinson, Yager, Humboldt County.—The Tall Oat Grass sowed in the spring, came up well, but seeded very little the first year. The second year it grew about five feet high, but the heavy late rains laid it down, so I got but little seed. Last spring I pastured it late, and got a good supply of seed from it last summer.

R. E. Merson, Bridgeville, Humboldt County.—The Tall Oat Grass has done well, and I think it is the same grass that I have been raising for the past eight or nine years; we call it "Kentucky Premium Grass"; the seeds look just alike, but the blades on the Oat Grass are of a different color from the "Premium," but that may be caused by a change of climate. I cut the "Premium Grass" twice a year, and have cut it three times one year. It makes more feed than any grass I ever tried, and will grow almost anywhere. We have it sown on the ranch, but the stock will not let it go to seed.

Geo. B. Pearce, Paradise, Butte County.—The Tall Oat Grass lived through the dry weather last summer, and the winter, and this year made a fine growth, but I think it got a little seepage from irrigating the orchard near by, as another plot nearly all died out.

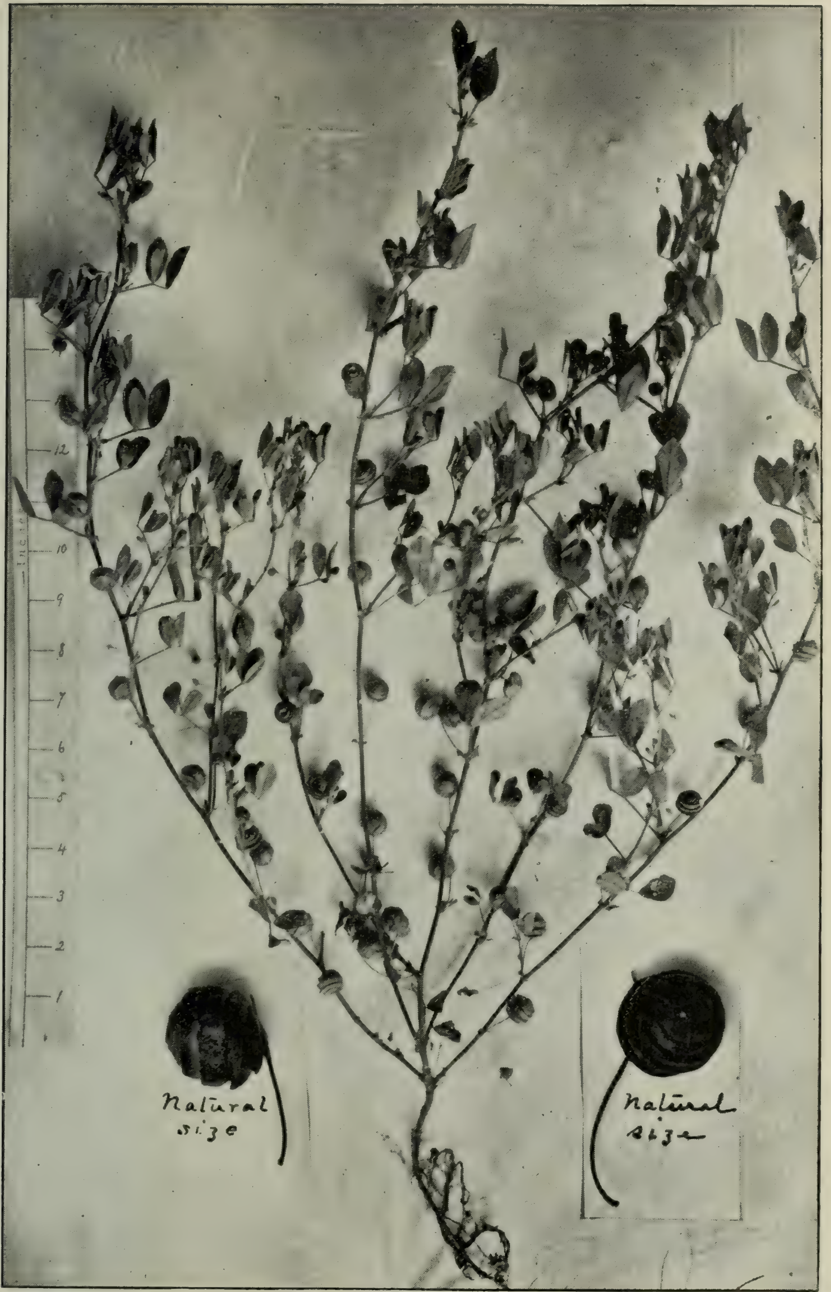


PLATE 4. SNAIL CLOVER. Plant reduced, as shown in scale of inches; seed-pod natural size.

Robert Hastie, Clayton, Contra Costa County.—I have been greatly disappointed in my larger sowing of Oat Grass. The water from the country road was turned on it, and every day it rained it got flooded, and it all died. The original plot is all right, but the crop was light this year. Too much water does not seem to suit Oat Grass. Sown on gray adobe it did fairly well; on loose, gravelly land a big crop, five feet high, was harvested.

C. A. Cary, St. Helena, Napa County.—The Tall Oat Grass did very well; I think it will do better next year.

H. E. Brown, St. Helena, Napa County.—Tall Oat Grass has done finely; I will try and sow an acre next year; though it grows in bunches, I think that hay will be the thing to plant with it.

Mrs. J. G. Robinson, Santa Clara, Santa Clara County.—Tall Oat Grass as food for animals and fowls is invaluable.

J. A. Girard, Cayucos, San Luis Obispo County.—The Tall Oat Grass and Japanese Wheat Grass gave me some seed, which I will put out at the next rain; but the other dry-land grasses, after making more or less growth, withered during the summer and did not come to seed. My experience is that, with many of these plants, considerable moisture is needed to start them and keep them vigorous, and that the seed should have been in the ground before the heavy rains last season.

E. R. Pierson, Raymond, Madera County.—Schrader's Brome Grass and Tall Oat Grass were the most satisfactory of the grasses. They both did well on dry land as long as they were protected, but in pastures have not been able to produce seeds, as rabbits and squirrels, as well as stock, assist in exterminating them.

U. S. Adams, Raymond, Madera County.—Tall Oat Grass I believe to be the best of all, although it dies if sown on wild land here; but I believe, if it were cultivated until well established, it would stay.

Henry Murphy, Milo, Tulare County.—Tall Oat Grass does finely here, but my stock would not eat it.

TEXAS BLUE GRASS (*Poa arachnifera*).—Quite full accounts of this grass have been given in earlier reports. Later observations indicate that it requires rather favorable moisture conditions, and does not thrive in the interior valleys without irrigation. Along the coast it is one of the best grasses, and will hold on well without watering:

J. B. Harbers, Waddington, Humboldt County.—Texas Blue Grass roots were planted in a row; most of them grew. The Blue Grass has blades now twelve to eighteen inches long, and is spreading to all sides.

W. H. Bailar, Fortuna, Humboldt County.—Texas Blue Grass has done well in this climate.

L. L. Guss, Brentwood, Contra Costa County.—Texas Blue Grass died out after one year.

U. S. Adams, Raymond, Madera County.—Texas Blue Grass stands drought very well, but is quite small.

J. J. A. Connelly, Bishop, Inyo County.—The Texas Blue Grass made but a poor growth this summer, but is now (November) doing better and looks as if it might spread and ultimately succeed.

H. E. Dye, Tulare, Tulare County.—The Texas Blue Grass seemed very poor the first year, but is stronger this year; but always had plenty of water.

Henry Murphy, Milo, Tulare County.—Texas Blue Grass roots failed to grow.

J. A. Girard, Cayucos, San Luis Obispo County.—I have in my garden a few nice bunches of Texas Blue Grass from the plants received from you, and I expect to gather seed enough for quite a patch next spring.

S. C. Dondore, Flinn Valley, Lakeside, San Diego County.—Texas Blue Grass has resisted the drought well, and is a success with us.

J. C. Lester, Vista, San Diego County.—Texas Blue Grass does well, but makes slow growth.

T. Docking, San Diego, San Diego County.—The Texas Blue Grass has done well.

OTHER FORAGE PLANTS.

The following brief extracts from correspondence relate to plants which have been fully discussed in earlier reports, and information concerning them can be supplied on application:

HUNGARIAN BROME GRASS (*Bromus inermis*).—*Thomas Dickinson, Yager, Humboldt County.*—Hungarian Brome Grass does remarkably well. It keeps green all the time; stock do not eat it till late in the fall or winter.

A. B. Leckenby, Bakersfield, Kern County.—Bromus inermis, sown October 22, 1894, made two full crops three feet high, and is still growing (October, 1895). This grass appears to be especially adapted to our soil and climate, and to be exceptionally good for grazing purposes—yielding abundant leaves, which grow better with frequent cutting.

SCHRADER'S BROME GRASS (*Bromus unioloides*).—*Robert Hastie, Clayton, Contra Costa County.*—Schrader's Brome Grass is doing well along the fence. I saved seed enough this year to try it as a hay crop next year.

A. B. Leckenby, Bakersfield, Kern County.—In selecting the most promising grass, all things considered, it is difficult to decide between *Bromus unioloides* and *Bromus inermis*. The former has certainly yielded the most of any grass, and the quality is appreciated by all stock; while the latter takes hold of the ground so deeply, and stands sunshine and drought so well, that we are inclined to award it first place. *Bromus unioloides* is said to be a winter grower; we have proved it to be also a summer grower, as three heavy crops have been cut from a sowing made February 18th, and it is still growing (October, 1895). Each crop was of mature seed, and four feet high.

JAPANESE WHEAT GRASS (*Agropyrum Japonicum*).—*F. Albright, Estrella, San Luis Obispo County.*—Japanese Wheat Grass looks well with water, but will not assert itself where I have planted in dry gulches and on hillsides. It is very fine for poultry.

Robert Hastie, Clayton, Contra Costa County.—Japanese Wheat Grass died out the third year.

A. B. Leckenby, Bakersfield, Kern County.—Agropyrum Japonicum made two good crops of seed, but did not grow during the hottest weather; it is now (October) doing finely, and we expect will be a good winter grass.

Edward Lester, Pasadena, Los Angeles County.—Japanese Wheat Grass came out pretty well, and the stand for this year so far (February) seems very healthy and strong. Cattle seem particularly fond of it, and I think it is likely to be a good fodder plant for the dry locations.

MANY-FLOWERED MILLET GRASS (*Milium multiflorum*).—*Thomas Dickinson, Yager, Humboldt County.*—Many-Flowered Millet died out, and it is a failure here.

H. H. Gird, Fallbrook, San Diego County.—Milium multiflorum, while not of much force on real dry land, is very vigorous on damp land, but not sufficiently damp for salt grass to thrive.

A. B. Leckenby, Bakersfield, Kern County.—Milium multiflorum is a vigorous grower with us, and makes very sweet hay. It made three crops from a late spring sowing, and is still growing in October. Its hard stems do not appear to be an objection, as they are not tough. We regard it with much favor as a future crop.

JOHNSON GRASS (*Sorghum halepense*).—*A. B. Leckenby, Bakersfield, Kern County.*—Johnson Grass has taken possession of much ground against the protests of man. All stock are fond of it, if not too old. It will yield three crops of good hay each season. It is easy to eradicate in our soil by close pasturing (for one season) with sheep. It will grow on all kinds of rich land and produce a good crop on most ground without irrigation. With us, close cutting (just below the surface) one season, will cause the roots to die. In localities especially adapted to grass and poorly adapted to fruit, it may be that this grass is of great value and a friend to the farmer, but is a bad weed in cultivated ground.

Byron O. Clark, Pasadena, Los Angeles County.—Any one introducing Johnson Grass into a community should have his property confiscated and be exiled; it is costing me $100 per acre to clean a patch that spread on to a choice piece of moist land of mine from a neighbor, who let it go wild instead of exterminating it.

KAFFIR CORN (*Sorghum* sp.)—*Mrs. N. L. Jacobs, Foster, San Diego County.*—Red Kaffir Corn grew well; the second crop is now (October) ripening seed. Stock seem to like it, and, altogether, I should think favorably of it as a forage plant, as it stood drought well.

ESPARCETTE, OR SAINFOIN (*Onobrychis sativa*).—*L. L. Guss, Brentwood, Contra Costa County.*—Esparcette made very poor growth, and finally died out.

G. B. Pearce, Paradise, Butte County.—Esparcette, after three years' trial, has proved a failure, as compared with alfalfa.

Mrs. M. J. Beaty, Kernville, Kern County.—Esparcette seems to thrive well in this climate.

JERSEY KALE.—*J. C. Hobson, Healdsburg, Sonoma County.*—Jersey Kale is quite a success here.

Robert Hastie, Clayton, Contra Costa County.—Jersey Kale on dry land is poor, but with plenty of water it makes a big crop. I had two plants, one four and the other five feet high; the leaves the longest way were twenty-eight inches, and seventeen inches broad. They were beauties.

E. R. Pierson, Raymond, Madera County.—Jersey Kale on moderately rich, moist soil is the most vigorous grower I have tried. Neither heat nor cold affect it, and it produces a large amount of forage.

Geo. Weiss, Creston, San Luis Obispo County.—Jersey Kale did very well, considering it was a very dry season.

BUCKEYE (*Æsculus Californica*).—*R. M. Rutherford, Cordelia, Solano County.*—Last year I planted Buckeye seeds. Stock are very fond of the leaves. The leaves come early, and shelter the grass under the trees. The Buckeye will grow on waste places.

FIELD AND GARDEN VEGETABLES.

NEW ZEALAND SPINACH (*Tetragonia expansa*).—This culinary herb has been very highly praised in earlier reports. Its fame is constantly extending:

Robert Hastie, Clayton, Contra Costa County.—New Zealand Spinach is fine. It got no rain or water at all till the September rain. It held its own through the hot spell and is doing finely since the rains came. I am also surprised at the amount of frost the plants have stood; they are not hurt in the least, and the potatoes are all gone.

J. H. Holt, Laurel Glen, Lafayette, Contra Costa County.—New Zealand Spinach is a wonderful grower; the plant the second year spread to fully seven feet in circumference, and kept bright green until frost came. A seed that came up this year from last year's planting spread out four feet in diameter; and the mass was eight inches deep, and nice and tender all through the last hot and dry summer; no water was necessary.

Wm. Crosby, Livermore, Alameda County.—The yield of New Zealand Spinach is large, but is a slow grower; quantity good. Plants now (January) in full vigor; have felt a little frost, but are still untouched.

W. Wehner, Evergreen, Santa Clara County.—New Zealand Spinach is extremely valuable.

A. Skinner, Wrights, Santa Clara County.—New Zealand Spinach is the best possible greens. A spot six feet square, trenched, and the trench filled with manure and ashes a foot deep, with a few inches of soil on top and with a thorough watering once a week, will supply a family with tender greens from spring frost to autumn frost. It is as nice in October as in May.

S. F. Thorn, Glenwood, Santa Cruz County.—The New Zealand Spinach has proved the best vegetable for greens we have ever grown, either boiled with beets, beet tops, radish tops, other spinach, or alone by itself. I have distributed the seed among many friends. They all like it. My place is twelve hundred feet elevation in Santa Cruz Mountains, being above the frost line; the plant grows here rapidly the year round. I have to cut it back and destroy it, because of its rapid growth.

W. A. Webster, Pylema, Kern County.—The New Zealand Spinach grew quite well upon sandy soil without irrigation. It showed effects of drought early in June, and I allowed the cows to harvest it, as they did with evident relish. I judge it would flourish on light sandy soil and give good result under a light supply of water.

E. A. Bonine, Lamanda Park, Los Angeles County.—We have had frost to kill tomatoes this season, but New Zealand Spinach was not hurt.

E. O. Kennard, Glendora, Los Angeles County.—New Zealand Spinach has proved very satisfactory. It is growing all winter, and will prove very valuable.

J. H. Fisher, Carlsbad, San Diego County.—Two years ago, New Zealand Spinach made very little growth. Last season, however, from one foot diameter it spread to ten, growing till midsummer, and two months previous to ripening or drying up, the ground at edge of plant, or rather at edge of foliage, was so dry and hard that it was impossible to plow.

M. W. Daie, Jamul, San Diego County.—The New Zealand Spinach lived through the dry part of the season, and, since the rains set in, has made a good growth.

S. C. Dondore, Flinn Valley, Lakeside, San Diego County.—New Zealand Spinach has been grown by me for two years, and is a success. It is superior to any of the other varieties as a table vegetable.

ZIG-ZAG SWEET CORN.—This variety was received from the U. S. Department of Agriculture, and its growth in Berkeley seemed to warrant a wider trial. It seems to have adaptations, and is probably entitled to a place among the accepted sorts:

C. A. Arfsten, Sisson, Siskiyou County.—Zig-Zag Corn did not get big enough for the table, though its growth was tall enough. I think the season is too short; our altitude is 3,585 feet.

James Dodge, Forest Ranch, Butte County.—Zig-Zag Sweet Corn was of fine flavor, and a very good crop. I consider it the best of four varieties I tried this year.

Wm. H. Hilton, Glen Ellen, Sonoma County.—Zig-Zag Corn was planted in good, loamy soil; did not do well. Cobs small, half filled with corn kernels. It is a poor variety, compared with other sweet corn.

Frank Bentz, Soulsbyville, Tuolumne County.—Zig-Zag Sweet Corn I regard as a very good late variety; very sweet and tender.

C. A. Cary, St. Helena, Napa County.—The Zig-Zag Corn (sweet) was a success; it is good.

Capt. W. Crosby, Livermore, Alameda County.—Zig-Zag Sweet Corn was planted March 12th. It is medium early—about the same as Black Mexican, and later than Early Cory. The yield is medium; quality fair—about as good as Early Cory, inferior to Black Mexican, but not much inferior to Improved Evergreen. In appearance the Zig-Zag is most beautiful. It is an excellent corn to sell to city greenhorns.

W. F. Waterman, Los Berros, San Luis Obispo County.—Zig-Zag Sweet Corn was planted on low, wet ground; about a dozen ears did not fill well.

A. C. Bertram, Anaheim, Orange County.—Zig-Zag Sweet Corn did fairly well, although not as satisfactory as some of our old varieties

Francis Beckwith, Altadena, Los Angeles County.—Zig-Zag Sweet Corn grew fine, and produced best ears of three or four varieties of sweet corn; all grown on dry foothill land.

Edward Lester, Pasadena, Los Angeles County.—We were much pleased with Zig-Zag Sweet Corn. It seems a good, steady-yielding plant, but much less subject to the worm-in-the-ear than any other kind we have had. It also comes well ahead for earliness.

PERENNIAL BEANS (*Phaseolus* sp. ?).—We have distributed two varieties of beans with perennial roots, which have attracted much attention. One, which we call "Melde's," is a handsome, large, white bean, with a perennial root, from which climbing runners start each year. The seeds and roots were donated by Henry Melde, of Eureka, Humboldt County, who found the plant at that point, the facts about its introduction not being obtainable. The other perennial bean, named the "Irvine," originated on the Station grounds, and is believed to be a cross between the Painted Lady and the Lima. It is larger than Melde's bean, plump, pure white. The vine shows a disposition to bear two crops in the summer, the second crop being fit for cooking in November and December, in regions where frost does not cut down the vines. The following reports show that the beans are of some value:

C. A. Arfsten, Sisson, Siskiyou County.—Both Melde's Bean and Irvine's Bean grew well, reaching seven feet high.

Mrs. E. M. Edwards, Olinda, Shasta County.—The Perennial Bean that you sent me for trial was a failure; it did not bear at all, and died first winter.

S. H. Bowles, Capay, Yolo County.—Melde's and Irvine's Beans made luxuriant vines, full of blossoms all summer; but the little striped and spotted bugs eat all the beans as fast as they formed until late in the fall, when the bugs disappeared, and in November the vines were full of very fine beans. I am well pleased with them.

James Dodge, Forest Ranch, Butte County.—Melde's and Irvine's Perennial Beans made a good growth, and were full of bloom, but only one pod formed before the storm we had in September; then there was quite a crop formed and ripened.

G. B. Pearce, Paradise, Butte County.—We are much pleased with Irvine's Hybrid Perennial Bean, and think it is as fine a bean as we have ever tried. It blossomed very freely all summer, though did not set very full of beans at any time. The plants were still growing when frost came.

Wm. H. Hilton, Glen Ellen, Sonoma County.—Irvine's Hybrid Perennial Bean is a good bean; crop fair, but less than the Lima. Melde's Perennial Bean grew, but did not seed, except one small pod.

A. H. Bradford, Decoto, Alameda County.—The Perennial Bean I consider a very valuable plant. They bear well and are perennial as represented. For this year, shoots came up from the roots and are bearing. The first year the striped bug attacked them, and nearly ruined them before I was aware of their presence. I gave them a dose of woodashes in the manuring, which drove them (the bugs) away, and now the plants are beginning to bear again.

H. H. Huettenberger, East Oakland, Alameda County.—Melde's Perennial Bean I am very much pleased with; it is a good bearer and cooks well, green as well as dried.

Wm. Crosby, Livermore, Alameda County.—Irvine's Hybrid Perennial Bean was planted in good soil, moderately moist, kept well hoed. Yield, medium in quantity; have not tested quality. Vines grew to three or four feet in length, and continued to blossom till late in fall; tops died down in January, and did not reappear the next year.

H. E. Brown, St. Helena, Napa County.—Perennial Beans grew strong and large; the blossoms completely covered the vines; it looked like one vast flower-bed; bore about one bean to two hundred blossoms.

Ira W. Adams, Calistoga, Napa County.—Melde's Perennial Bean blossomed abundantly in the early summer, but no beans set. Later on it blossomed again, and is now (December) full of beans; the frost has not damaged the vines as yet.

C. Hummeltenberg, Santa Clara, Santa Clara County.—Melde's Perennial Bean did very well, bearing quite heavily. For cooking, when green, I found that they had to be picked quite young, or else they became hard and stringy.

Wm. Beauchamp, San José, Santa Clara County.—Melde's and Irvine's Perennial Beans are good for string beans, or as fully grown. Both very desirable and prolific, and quite hardy for beans. I failed to see the difference in the two.

Dr. Edmund Goldmann, Villa Bergstedt, Wrights, Santa Clara County.—Melde's Perennial Bean has proved to be quite a valuable addition to our vegetable garden. It brought an abundance of pods, with very large beans, which beans, when cooked fresh, make a very good dish. They have sprouted early from their roots, and promise now to give us a fresh crop, long before any other kind of beans in our garden.

S. F. Thorn, Glenwood, Santa Cruz County.—The Melde's Perennial Beans have also thrived luxuriantly on my place.

R. S. Nougaret, San Ardo, Monterey County.—Melde's Perennial Bean and Irvine's Hybrid Bean did well in the start, but seemed to sunburn very easily.

Daniel Cox, Pacific Grove, Monterey County.—We had a dry spring, and it was very severe on Melde's Bean. They did not come up until we got rain. The bean is a large white, and very productive; the most prolific I ever knew.

Frank Bentz, Soulsbyville, Tuolumne County.—Melde's and Irvine's Perennial Beans did well as to growth, and have bloomed profusely, but up to time of writing (September 28th) have set but about half a dozen pods on all the vines.

U. S. Adams, Raymond, Madera County.—Perennial Bean grew good, but failed to bear any beans.

H. S. Haskel, Porterville, Tulare County.—Melde's Perennial Bean grew and bloomed, but sunburned so badly that I fear it will not do any good.

Henry Murphy, Milo, Tulare County.—Melde's and Irvine's Perennial Beans failed on account of drought.

J. A. Girard, Cayucos, San Luis Obispo County.—Melde's and Irvine's Perennial Beans bore quite a crop.

N W. Blanchard, Santa Paula, Ventura County.—I received, last winter, a package of Perennial Beans, and they were all planted in one hill. I have now one hundred and nineteen beans, and a very few others were perhaps lost. The plants have commenced to grow again, and next season I shall have enough to test their edible quality. They are large and perfectly white, like the original ones.

Vivian Jones, Round Valley, Inyo County.—We had killing frost as late as June 15th. The Melde's Beans grew well, but frost killed them before they matured.

E. O. Kennard, Glendora, Los Angeles County.—The Perennial Bean has shown itself to be an excellent vegetable.

Mrs. Almeda Frakes, Elizabeth Lake, Los Angeles County.—The Perennial Bean grew finely, bloomed all summer, but gave no beans till late in the fall, and only about half of them got ripe; but I saved enough ripe to plant quite a lot next year.

M. K. Chandler, Dundee, Los Angeles County.—Melde's and Irvine's Perennial Beans I planted alongside of the common Lima bean, in a granite soil, last March. The former matured a fair crop a little earlier than the Lima, and then was done, while the Lima has borne almost continuously till now, and we are still picking from them.

Mrs. L. S. Cleland, Mesa Grande, San Diego County.—We received enough of the Perennial Bean to test its culinary qualities, and all who ate it pronounced it superior to anything in the bean line they had ever tasted. I have saved the roots and quite a quantity of seed, and hope soon to have enough of this rare novelty to divide with my neighbors. If we could only prevent the rust or mildew, which drops the flowers and turns all the leaves yellow.

H. H. Gird, Fallbrook, San Diego County.—Melde's Bean is of a fair quality as a table bean; but whether its being a perennial plant is of any advantage, I have not yet determined.

J. C. Lester, Vista, San Diego County.—Irvine's and Melde's Perennial Beans are good growers and of good quality—about the same as the Lima bean; but they do not shell so badly.

S. C. Dondore, Flinn Valley, Lakeside, San Diego County.—Melde's and Irvine's Hybrid Perennial Beans are a success; they yield well.

T. Docking, San Diego, San Diego County.—Melde's Perennial Bean only did fairly well; Irvine's did not bear well.

NEW SHORT WHITE CARROT.—This variety was received by the Station from the introducers, Steele Bros. & Co., Toronto, Canada. It is a large, short carrot, heavy at the shoulder, and easily pulled from the ground; flesh solid, crisp, and sweet. It proved to be valuable in our trial at Berkeley. The following is the record it has made throughout the State:

R. E. Merson, Bridgeville, Humboldt County.—The White Carrots did well, and we had carrots big enough to eat in five weeks from sowing.

J. B. Harbers, Waddington, Humboldt County.—Short White Carrots were planted the 14th of April, with red carrots, in rows fifteen inches apart, on sandy, well-manured soil; the patch had the same cultivation. They were dug the 15th of November, and came out smoother and cleaner than the red. One rod of the white weighed eighty pounds, while the red on one side weighed forty-two pounds, on the other side forty-three pounds—all without tops. Gophers had damaged the red more than the white.

W. H. Bailar, Fortuna, Humboldt County.—The New Short White Carrot does extra well here.

Wm. E. Whitmore, Whitmore, Shasta County.—I was unable to plant my Short White Carrot seed till nearly June 1st. As it was dry for a few weeks, they did not all come up; but enough came up to show me its superiority for our shallow soils over a longer carrot, at least for stock; although my brother (J. H. Whitmore) and a neighbor (W. A. Morgan), who planted theirs early in the season, did not like the carrot for table use. A few specimens of those that I saw would weigh over two pounds.

R. H. Barkway, Rio Vista, Solano County.—New White Carrot, planted on the first day of March, came up well and grew well; it is quite early, and makes an excellent table carrot.

Martin Ott, French Camp, San Joaquin County.—Short White Carrot did splendidly in bottom land, and is very palatable. It is better to the taste than the regular yellow one.

H. H. Huettenberger, East Oakland, Alameda County.—We think the White Carrot is very fine for the table; it is sweet and tender.

Wm. Beauchamp, San José, Santa Clara County.—Early Short White Carrots are very fine for table use; the best I know of.

Stephen Barker, Gilroy, Santa Clara County.—The White Carrots did well, being quite mild in taste.

Frank Bentz, Soulsbyville, Tuolumne County.—The Short White Carrot is a most wonderful variety. I have specimens at hand measuring three and a half inches in diameter, and from eight to ten inches long. I regard it as an excellent variety for stock-feeding and also for table use.

Minnie Neligan, Creston, San Luis Obispo County.—The White Carrot grew to be of good size, and has a nice flavor.

S. C. Dondore, Flinn Valley, Lakeside, San Diego County.—The New Short White Carrot is a decided success with me, and is superior to any of the other varieties as a table vegetable.

J. C. Lester, Vista, San Diego County.—The White Carrot grows well, but is not as good as the yellow.

T. Docking, San Diego, San Diego County.—White Carrots have done remarkably well; I have excellent roots now in my garden.

FRUITS.

THE LOGAN BERRY.—This new fruit introduced by this Station, and fully described and illustrated in our Report for 1892–93, is becoming very popular. The following are early reports concerning it. Another year's growth in the hands of our correspondents should more fully determine its value:

George B. Pearce, Jr., Paradise, Butte County.—The Logan Berry bears nice, large, finely flavored fruit. I am much pleased with it.

H. E. Brown, St. Helena, Napa County.—The Logan Berry made eight feet of growth and fruited reasonably well on adobe land. I think that Cuthbert Raspberry and Lawton Blackberries are far superior in flavor. The Logan Berry will make a good shipper.

J. C. Hobson, Healdsburg, Sonoma County.—The Logan Berry grew splendidly. I would prefer them in every respect to the tame or wild blackberry.

A. W. Bradford, Decoto, Alameda County.—The Logan Berry is somewhat superior to the raspberry, but in shape it is more like what I used to know as the wild thimbleberry; in color it is a dark purple. I do not think it so good a fruit as the blackberry, by a long way; but still think it a valuable variety.

A. Clark, East Oakland, Alameda County.—The Logan Berry received January, 1894, is proving a perfect success in this soil and climate. The growth of the vines is wonderful, and the fruit is large; they commenced ripening before raspberries did.

Wm. Lester, San Bernardino. San Bernardino County.—The Logan Berry made a very rank growth; six branches were each from twelve to fifteen feet long.

TREE TOMATO OF JAMAICA (*Solanum betaceum*).—This plant is a native of Central America, and is grown in semi-tropical South America and in the Mediterranean region. Mr. D. Morris, of Kew Gardens, London, describes the plant as of shrubby habit, growing five or six feet high, with large, shining leaves, often a foot long. The flowers are fragrant, of a pale flesh color, with yellow stamens, and are followed by fruit the shape and size of a duck's egg; at first of a purple tint, but gradually assuming a warm reddish color as it ripens. When ripe the fruit may be used raw, as a tomato is; if the skin be removed and the fruit stewed with sugar, it has a slight sub-acid flavor which is very refreshing.

We are indebted to Mr. J. H. Cammack, of Whittier, Los Angeles County, for a supply of fruit, from which we took the seed for distribution in 1894–95.

The plants bear the second year from the seed, and the fruit ripens continuously for several months. It is not expected that the fruit will be of any commercial importance, but may be popular for home use, and the plant will be acceptable to all who enjoy striking semi-tropical vegetation, for it has large, glossy leaves and showy fruit. It is quite a tender plant, and not likely to be satisfactory, except in regions of light frost. The following are preliminary reports:

C. W. Snyder, Eden Vale, Santa Clara County.—The Tree Tomato made a growth of about three feet, and blossomed, but did not fruit. The frosts have stripped the stems bare, but they are still green.

J. A. Girard, Cayucos, San Luis Obispo County.—The Tree Tomato of Jamaica, whose seeds were put into a box and well attended to, proved a failure; the plants grew for some time, and finally died.

Frank Bentz, Soulsbyville, Tuolumne County.—I succeeded in raising a number of plants of the Tree Tomato of Jamaica, which seemed thrifty until they were taken from hotbed and planted in open ground, when they finally dwindled away and died. I think that this climate is too cold for them. The small green cabbage worms are very fond of them.

Mrs. Almeda Frakes, Elizabeth Lake, Los Angeles County.—Only five seeds of the Tree Tomato of Jamaica came, and all died when I transplanted them.

Mrs. Theresa C. Keys, Alhambra, Los Angeles County.—The Tree Tomato seed came up well, and I have given some of the trees to my friends. They make a tropical-looking plant. The frost of last week, when the mercury fell to 30°, took the tops of the Tree Tomatoes and the leaves. Whether the trees are hurt, I do not know; they must be very tender.

Byron O. Clark, Pasadena, Los Angeles County.—I do not think that the *Solanum betaceum* you offer will take a place of any commercial value, but is worthy of a place in general collections. I find the acid becomes tiresome to the taste, and not, like the tomato, agreeable. From continued use and from a careful test I speak, to make it useful, but was disappointed.

J. H. Cammack, Whittier, Los Angeles County.—The Tree Tomato usually branches but little until three to five feet high, and then commonly branches in three directions; afterwards branching is irregular. I sent one trial box of the fruit to Chicago, and they sold at 10 cents per pound; next year I will doubtless have them in abundance. The tree and the fruit both attract much attention, and more favor than I expected.

A. C. Bertram, Anaheim, Orange County.—Tree Tomatoes of Jamaica are a total failure; seed sown in bed at the same time as common tomato germinated and grew to one half inch, then withered and died.

L. H. Dawson, South Riverside, Riverside County.—A heavy frost, the thermometer registering 31°, killed the Tree Tomato.

A. THE FOOTHILL CULTURE STATION.

Five miles north-northeast from Jackson, Amador County.

By Charles H. Shinn.

In continuance of the general plan of annual Station reports, this article upon the Sierra Foothill Station is intended for the general reader as well as the specialist, and contains not only a detailed account of the present condition of the orchards, vineyards, and various cultures, but also includes a survey of work already done, and some memoranda upon the surrounding district. The Foothill Station has been more difficult and expensive to establish than any other under University charge, and its full utility will perhaps be later in development; but its usefulness is already recognized, and the greater difficulties of its establishment now seem measurably surmounted.

Since the last report a large Indian reservation has been established by the Government, on land adjoining the Station. The effect of this upon the Station itself remains to be seen. Such a reservation is not likely to be of any particular advantage, except as it brings in a few intelligent officials. Everything will depend upon the local management of the reservation, which seems likely to be in excellent hands.

The proposed electric railroad from Ione at least to Sutter Creek now appears likely to materialize, and, if so, it will be worth a good deal to the Experiment Station. Jackson, the nearest town, has experienced quite a revival of mining interests during the past year, and is more prosperous, so that the district generally is in better condition than at the time of my last report, and more interest is shown by the community at large in the welfare of the Station.

Botany of the District.—The Amador Experiment Station is situated in an exceedingly interesting botanical district. A visitor leaving Ione, the terminus of a branch railroad from Galt, reaches Jackson, the county seat of Amador County, after a stage ride of twelve miles. Galt is on the level floor of the Sacramento Valley, less than a hundred feet above the sea. The town of Ione, in the edge of the foothills, has an elevation of about 270 feet, and some of the farm-houses that look down upon it from the rim of adjacent hills, are fully a hundred feet higher. Jackson, which lies in a mountain hollow, is 1,300 feet above the sea, and the Amador Experiment Station, five miles beyond, is on three hills, the highest of which is close upon 2,000 feet in elevation (1,975, to be exact).

Some of the valley plants extend to the University station, and some of the Sierra plants descend to that region. Mr. George Hansen, foreman of the Station since its establishment, has devoted much attention to the botany of Amador and Alpine counties, from Ione to the heart of the Sierra, many miles east, in Faith, Hope, and Charity Valleys, on the old Nevada stage road, 8,000 feet above the sea. In a pamphlet, "Where the Big Trees Grow," published in January, 1895, Mr. Hansen lists more than eight hundred species collected in Amador County. *Quercus Wislizeni* is found as high as the Station district; the last of the buckeye is also here, and a few *Ceanothus tomentosus*. From higher altitudes one finds *Fraxinus Oregana*, *Cornus Nuttalli*, *Cerasus demissa*, *Ribes amictum*, and, as Mr. Hansen writes, "a solitary *Cornus pubescens*."

It is a remarkable oak country, the home of *Q. Kelloggii* and *Q. chrysolepis*, as well as *Q. Wislizeni*. The leading oaks collected by Mr. Hansen are the following:

At elevations of from 2,000 to 4,000 feet	Quercus chrysolepis.
At elevations of from 1,000 to 2,000 feet	Quercus Douglasii.
At elevations of 3,000 feet	Quercus Garryana.
At elevations of 2,000 feet	Quercus Kelloggii.
At elevations of from 1,000 to 3,000 feet	Quercus lobata.
At elevations of from 1,000 to 3,000 feet	Quercus Morehus.
At elevations of from 7,000 to 8,000 feet	Quercus vaccinifolia.
At elevations of from 7,000 to 8,000 feet	Quercus Wislizeni.

In addition to the above, Mr. Hansen has listed several distinct forms of *Q. Kelloggii* and other species, and numerous very interesting hybrids, chiefly between *Q. Kelloggii*, the black deciduous oak, and *Q. Wislizeni*, the black live oak.

When this country was first settled, it was as notable for its conifers as for its oaks. There were fine forests of *Pinus ponderosa*, and many trees of *P. Lambertiana*, besides the *Libocedrus decurrens*. *P. Sabiniana*, more abundant at lower points, becomes scarce here, and *Abies Douglasii* begins to appear in superb forests a thousand feet higher. The range of *P. ponderosa* begins at about 1,000 feet, while the *P. Lambertiana* zone commences at about 2,000 feet. Both are found in their full glory at an elevation of 4,000 feet. The zone in which *Juniperus occidentalis* and *Pinus contorta* appear begins nearly 2,000 feet higher than this. The Sierra Foothill Station is at the gateway to what is botanically one of the less explored regions of the high Sierra. Some of the larger problems of California forestry, as well as those which deal with foothill horticulture, must be studied at this Station, and the importance of this and similar stations, in the easily habitable Sierra territory between the elevations of 1,500 and 3,500 feet, is certain to increase.

Illustrations.—All of the illustrations in this report on the Foothill Culture Station are reproduced from charts and drawings made by the foreman, Mr. Hansen. The great reduction necessary to bring them down to the requisite size has caused proportionate loss in distinctness.

Survey Notes of the Station.—In pursuance of the plan of surveying and charting one Station after another, the present report deals more in detail than do previous reports with the area, soils, contours, and other physical data pertaining to the Sierra Foothill Station. Illustrations which accompany the text, reduced by photography from the original charts, serve to more fully explain the subject.

The Station tract consists of thirty-five acres, as surveyed, received under the following subdivisions: From John Boggs, twenty-two acres; from the "Italian tract," seven acres; from Mrs. McKay, six acres.

About twenty-seven acres are under plow. Culturally considered, the slopes must be counted as making more labor. We usually have assumed that, if the entire thirty-five acres were under cultivation, the tract might fairly be rated as equivalent to forty-three acres. The lowest point on the Station grounds, the waterworks, is 1,775 feet above the sea.

Approaching the Station by the usual road from Jackson, a side road, which leaves the main Jackson-Volcano stage-line at an elevation of 1,500 feet, winds up a ravine in a northwesterly course, rising some 330 feet, and turning to the main entrance of the Station, which is between two hills. From this point across the Station tract, it is named Olive Avenue, being lined with olive trees of different varieties.

There are three hills fairly well included in the tract, and its diversified surface will repay careful study. The general trend of the tract, considered as a mathematical figure, is southwest and northeast, and it is nearly twice as long as it is wide. The southwestern half of the tract consists chiefly of red soil, some very poor, some excellent; and a small piece of less than an acre in the extreme northern corner is also red soil. With this exception, the entire northeastern end of the tract is decomposed granite; but nearly an acre along the mining ditch is covered with waste granite rock, blasted out when this famous ditch, the Amador Canal, was constructed to bring water from the high Sierra.

The main Station road, Olive Avenue, entering, as noted, from the southwest, at an elevation of about 1,830 feet, follows the natural rise of the hollow between two hills, till, 40 feet higher, upon the "saddle," it meets a curving road rising on the right hand to the top of Residence Hill, now named Fairview; and also meets, on the left hand, another road ascending to the top of Reservoir Hill. The main road descends nearly 20 feet past the stables, workshop, and wagon-sheds, and 80 feet farther, to the neighborhood road, which follows the general course of the canal, and leads on the west to New York Ranch, two miles, and Sutter Creek, nine miles distant; and, on the east, to Pine Grove, four miles away.

Descending to the lowest surveyed point, the waterworks, on the Amador Canal, where a small turbine wheel lifts the Station supply, it is to be noted that the surface rises beyond the canal to the north and northeast (the six acres of the McKay tract) to nearly 40 feet above the ditch bank. This is a regular and attractive slope, free from gullies, but has been expensive to clear, and considerable work remains to be done, both in grubbing out roots and in removing granite rock. South and southwest of the canal the surface again rises, on the right hand to the top of Reservoir Hill, on the left hand to the smaller hill near the barn, and, after crossing the head of a ravine, rises to the summit of Fairview. Since the main Station road, which keeps in the hollow, is before us, the contour lines curve away on either side, and, as we ascend, the coarse sand of the decomposed granite soil slowly begins to show the tinge of the red wash from the ridges. Twenty feet above the ditch carries us into the lower portion of the granite-soil orchard, on the right hand; on the left, into the experiment plots of hay crops. Forty feet above the ditch we are still in orchard and hay field. Sixty feet carries us to vineyard, on both sides; and on the extreme left hand, to remains of the wild growth of shrubs and trees, partially cleared. The 80-foot contour line on the left-hand side marks out the sweep of the oak-clad, rocky hill, which rises 30 feet higher, and overlooks the barnyard, wagon-

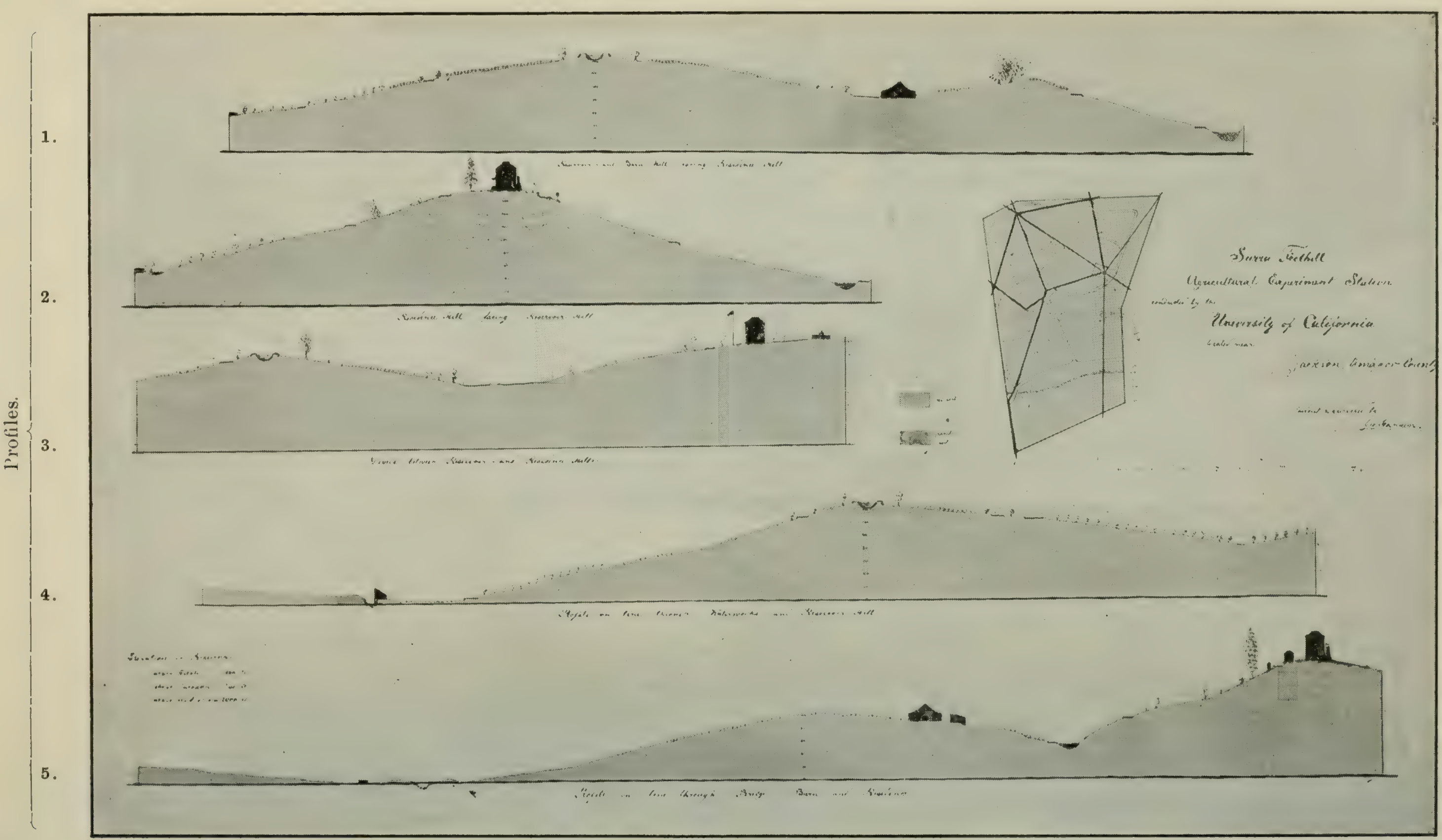


CHART I. SHOWING ELEVATIONS OF FOOTHILL STATION. (Reduced from large chart.)

shed, and other farm buildings. Excepting for avenues of fig and olive, and a little deciduous tree planting, a continuous vineyard ascends the slope on the right hand, above the granite-soil orchard surrounding Reservoir Hill. The 140-foot contour line forms a small circle near the crest of the hill.

Still ascending the main road to the base of Fairview Hill, one sees that the cañon on the east, behind the barnyard, drops off sharply, descending 60 feet in about 300 feet of distance. The rise beyond, towards the cottage on the hill, is steep; 350 feet here, in a straight climb, means a rise of fully 130 feet, according to the survey. But some of the best red soil of the Station is on this abrupt, northeasterly descent, and parts of it can be planted to deciduous fruits, with proper care in terracing. The usual footpath up the hill from the crossroads ascends 70 feet in a distance of 250 feet, but the wagon road makes a very reasonable grade by going three times as far around the curve of the hill. On the right hand, the southwestern slope of Reservoir Hill, covered, below the vineyard line, with red-soil orchards, descends to the 60-foot level, near the southwestern entrance, and towards the extreme southwestern corner the surface again rises, being the edge of another hill, where the red soil is again mixed with granite, like the soil on the top of Fairview Hill, and is inferior for orchard purposes.

Profiles of the Station Tract.—There is little more to add respecting the general topography of the Station, except to say that it is also illustrated by the five profiles to be seen in the accompanying plate. The five profiles are here described in their order, as charted, beginning at the top. The full-page plate also contains a small chart, on which the profile lines are traced, showing how said profiles intersect the plane of the Station tract. The top of this small chart is pointed a little west of south, instead of north, as is usual in such charts; in other words, it has been made to face the county seat and the valleys below.

Profile 1, a long and angular cut, about 1,550 feet in total length, begins at the main entrance gate (top of small chart); thence to the top of Reservoir Hill; thence, at right angles, to the barn flat; thence, past the crest of a smaller hill, and down the slope to the left-hand side of the chart. It shows the Reservoir Hill and the Barn Hill facing the Residence Hill.

Profile 2, which shows the Residence Hill facing the Reservoir Hill, begins at the main entrance gate (top of small chart), and extends through the summit of Residence Hill, and to the base of that hill, in the ravine (left-hand side of chart). It shows a part of the new orchard (left-hand side of the profile), some native oaks, a large pine tree, terraces about the house, the house itself, and, at the extreme right, the "making of soil" in the gulch, behind a barrier of rocks and logs. This profile cuts into the Residence Hill at nearly a right angle, giving a total length of 1,100 feet, and so the hill appears less steep than it really is.

Profile 3 represents the divide between the Reservoir and the Residence Hills. Its total length is 1,050 feet. It begins on the extreme right-hand side of the small chart and extends in a straight line across the tract—the only profile that is without an angle. Referring to the profile itself, we notice a portion of the orchard and vineyard on Reservoir Hill (left-hand end of profile), the divide between the hills (Olive

Avenue), and, at the right-hand side, the flagstaff, residence of foreman, and propagating house, in the order named.

Profile 4 is long, and contains but one angle, of about 45 degrees. Its length is 1,600 feet. It can be traced on the small chart, beginning at the bottom of the map and extending upwards to the top of Reservoir Hill, thence to the upper right-hand corner of the map. The profile shows, at the left hand, the descending slope to the mining ditch, then the ditch and pump-house, then road, orchard, vineyard, etc., to the Reservoir, the vineyard and orchard to the boundary line at the extreme right.

Profile 5 is the longest, and one of the most interesting of the series. Its total length is 1,850 feet, and it may be traced on the small chart from its point of beginning, at the extreme left-hand corner, bottom of map, thence through Barn Hill and Residence Hill. Its general course is west of south, and it makes two considerable angles. The profile, beginning at the left, shows the slope of the ditch past one of the lower gates, the vineyard on the Barn Hill, the descent to the ravine, and, at the extreme right, the buildings on Residence Hill.

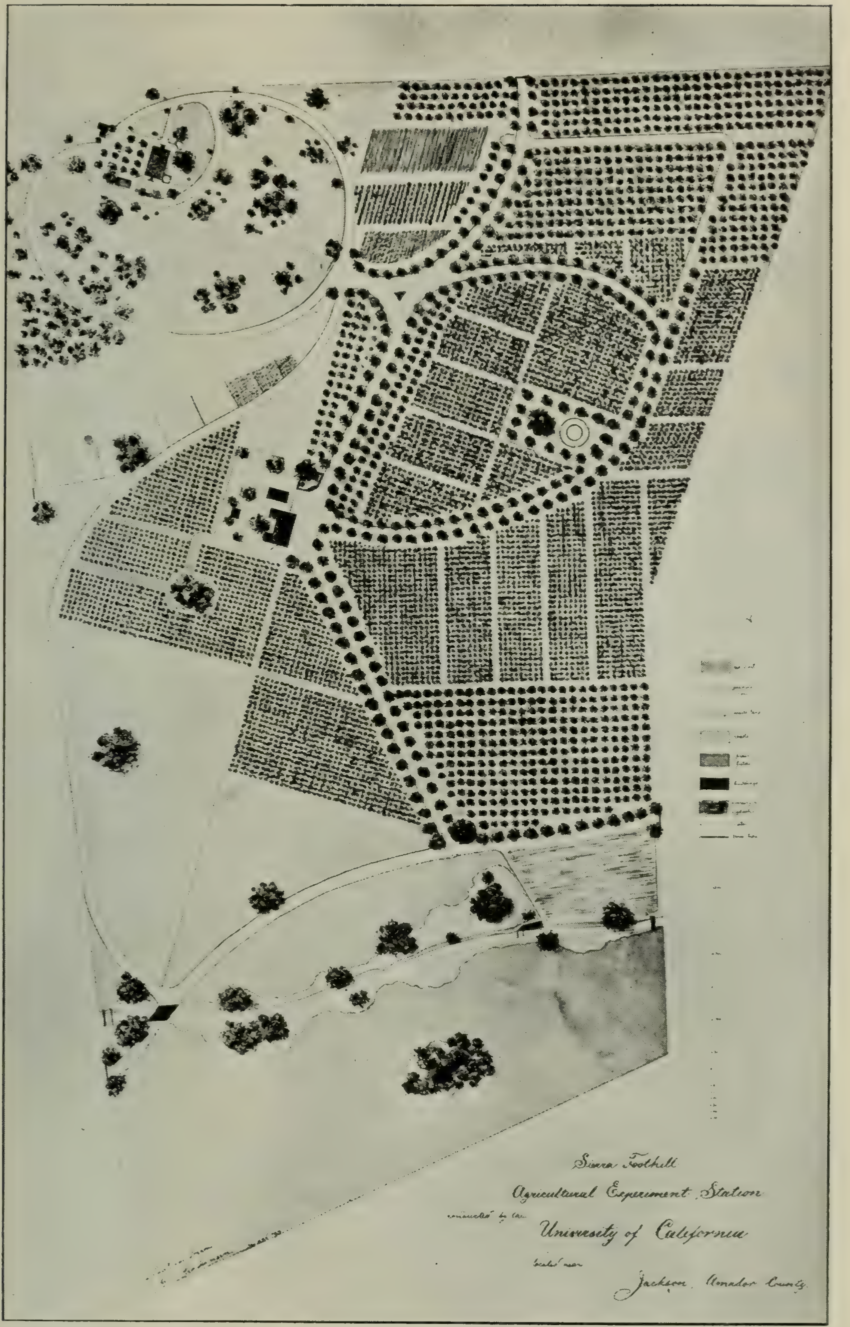
General Plan of Plantation.—Again returning to the main entrance, and crossing the Station by Olive Avenue, the general scheme of the plantation is manifest. The accompanying chart was made by Mr. Hansen to look toward the south, thus placing the entrance on the upper side. The road leading to Jackson is on the upper side of the chart, as now made, or south of the Station. We enter, on a rising slope, facing northeast. On the left hand are almonds, pears, and quinces, with some apples in the extreme southwestern corner; on the right hand are nectarines, apricots, and the beginnings of a new orchard on Residence Hill. A few steps farther brings us to the block of peach trees on the left hand, with plums and prunes beyond the side road to the reservoir; and the avenue of twenty-two olive trees carries one to Walnut Place, the joining of several roads, where thirteen walnuts stand.

Twenty more olive trees on the now descending main avenue bring us to the open space at the barn. The hill, rising on the left, is bordered with rows of almonds; beyond, on the rise and about the Reservoir Hill, is the upper red-soil vineyard. It contains, in divisions, 12 Port grapes; in another, 320 Southern French; in a third, 126 Sherry and Madeira; in a fourth, 140 Bordeaux; in a fifth, 134 Hungarian and Austrian; in a sixth and seventh, respectively, 86 and 124 Rhenish. Beyond Fig Avenue, which circles around Reservoir Hill, and practically an extension of this red-soil vineyard, are additional divisions, which contain 200 Raisin and Table grapes, 100 Burgundies, and 100 more of Austrian and Hungarian varieties.

On the right of this portion of Olive Avenue, the ground descending to the ravine, forms a small, sheltered basin, in which are several rows of representative cherries, being the red-soil cherry orchard. Strawberries and other small fruits are in this vicinity.

Olive Avenue, below the barn, to the canal, contains thirty-two trees—a total of seventy-four olive trees on the entire avenue, all representative varieties, and forming one of the most important collections at the Station. On the left hand, still descending, is the long, northeastern slope of Reservoir Hill, granite soil, somewhat mixed with red on its upper edges, and here is the second large vineyard. Its subdivisions consist

(South.)



PLAN OF FOOTHILL STATION, LOOKING SOUTH. (Reduced from large chart.)

of 129 Burgundies, 340 Sauternes, 210 South French, 174 Bordeaux, 140 Raisin and Table, and 130 Rhenish, besides Resistant and American vines. On the right hand, the slope ascends, still in granite soil, and here is a newer vineyard, whose subdivisions consist of 124 Port, 81 Sherry and Madeira, 343 Persian and Italian, besides two large blocks of still later additions around and over the crown of the hill.

Half-way down the slope of Olive Avenue, the vineyard on the left hand ends, and the granite-soil orchard begins. Here are cherries, plums, pears, peaches, nectarines, apricots, almonds, and apples, filling up the remaining slope to the bottom of the hill, where a line of mulberries extends along the road. On the right hand, towards the bottom of the slope, are plots for experiments with various fertilizers, and a part of the hayfield. Higher up, along the borders of the tract, some woodland remains.

These various orchards and vineyards are shown in the general chart of the entire tract as planted.

Local Support of the Station.—There has been a marked growth in local interest in the Station, since the date of my last report, due chiefly to the personal efforts of our efficient patron, Judge R. C. Rust of Jackson, of Mr. George Mack of Ione, County Superintendent of Schools, and of the editors of the Jackson, Ione, and Sutter Creek newspapers. Judge Rust's address before the District Fair in 1894 made particular reference to the work of the Foothill Station, and an increased number of visitors from among the farmers was immediately noticed. It is still true, however, in a marked degree, that the very men who most need to study the Foothill Station, though some of them live within easy driving distance, have never thought it worth while to spend any time there. Fruit-growers have come from adjacent foothill counties to spend a day at the Station, and have felt themselves amply repaid for the trouble; and we may have confidence that in time a much larger percentage of the local farmers will learn to utilize the advantages the Station affords. Not only from the foothills of Amador, but also from Calaveras and Ione, farmers can readily reach the Station with teams. The two main approaches for the valley people are by rail and stage from Lodi or Galt. In April, May, and June, the foothill country is exceedingly beautiful, and more persons should take the journey. Orchardists and viticulturists would find more of interest in September and October. There are no accommodations at the Station itself, but good mountain fare and efficient service can be had at reasonable rates in Jackson, Sutter Creek, or Pine Grove.

THE ORCHARDS.

The various orchards on different soils and exposures justify careful study. In the following notes upon the separate orchards, the small size of some of the fruits, as compared with other and irrigated mountain districts, cannot but be observed. This season (1895), water is being sparingly supplied to the orchard, so as to compare results with those of the last two seasons.

Almonds.—The almond districts in California are limited in extent, so that large losses have been incurred by planters who have invested too hastily, before the fitness of a given locality was fully tested. In fact, the experience of recent years tends rather to narrow than to enlarge the areas of safe almond culture on a commercial scale. Tests of the almond constitute, therefore, an important part of the work of all the Experiment Stations, and the various reports on this subject should receive the attention of every orchardist.

During the season of 1894, observations were made at the Foothill Station, upon fourteen varieties. The following table exhibits the comparative statistics for 1894, upon twelve leading varieties, all upon red soil, and all for six years, except Commercial (five years), and Routier's Twin and Texas Prolific (four years):

ALMOND STATISTICS.

Variety.	Foliage.		Flowers.		Husk Opened.	Fruit Ripe.	Nuts in a Pound	Total Weight, in Pounds
	First.	Full.	First.	Full.				
Commercial	Mar. 8	Mar. 20	Feb. 13	Feb. 28	Sept. 23	Oct. 8	161	½
Drake's	Mar. 17	Mar. 24	Mar. 26	Apr. 2	Sept. 2	Sept. 18	138	17
Harriott's	Mar. 8	Mar. 20	Feb. 11	Feb. 27	Sept. 27	Oct. 11	173	1½
I X L	Mar. 23	Apr. 1	Feb. 28	Mar. 12	Aug. 4	Aug. 28	140	4½
King's	Mar. 24	Apr. 2	Mar. 1	Mar. 11	Aug. 2	Aug. 28	280	¾
Languedoc	Mar. 28	Apr. 3	Mar. 10	Mar. 19	Sept. 6	Sept. 18	164	13
Marie Dupreys	Mar. 22	Mar. 29	Feb. 27	Mar. 11	Aug. 2	Aug. 31	104	¾
Papershell	Mar. 18	Mar. 28	Feb. 23	Mar. 10	Aug. 24	Aug. 31	203	1¼
Pistache	Mar. 30	Apr. 4	Mar. 22	Mar. 25	Aug. 26	Aug. 31	264	¼
Routier's Twin	Mar. 29	Apr. 2	Mar. 21	Mar. 24	Sept. 10	Sept. 21	-----	few.
Sultana	Mar. 18	Mar. 29	Feb. 24	Mar. 10	July 30	Aug. 27	221	½
Texan Prolific	Apr. 1	Apr. 6	Mar. 19	Mar. 25	Sept. 18	Sept. 26	208	1½
Nonpareil	Mar. 24	Apr. 2	Mar. 12	Mar. 20	July 29	Aug. 27	233	½

Arranged in order of yield, Drake's Seedling bore 17 pounds, 138 nuts to the pound; Languedoc bore 13 pounds, 164 nuts to the pound; I X L bore 4½ pounds, 140 nuts to the pound; Texan Prolific and Harriott's Seedling, each 1½ pounds, 208 and 173 nuts to the pound, respectively; Papershell, 1¼ pounds, 203 nuts to the pound; King's Softshell and Marie Dupreys, each ¾ of a pound, of respectively 280 and 104 nuts to the pound; Commercial and Sultana, ½ pound each, of respectively 161 and 221 nuts to the pound; Pistache, ¼ pound, of 264 nuts to the pound.

Drake's Seedling and Languedoc, according to this, are the only varieties that give promise of usefulness in this foothill district, 2,000 feet above the sea, and both have comparatively hard shells, but are of excellent quality.

Respecting the weather, Mr. Hansen reports: "Last season brought colder days than ever before observed during the six years since the Station was established. The mercury went as low as 22° Fahr., and a slight snowfall of about one inch on March 2d and 3d ruined the otherwise bright prospects of a few almond varieties. I X L, King's Softshell, Marie Dupreys, Papershell, and Sultana suffered seriously in their fruiting. Moreover, I feel that a gumming in the kernels of those varieties injured was partly due to the injury of their blossoms. King's Softshell was the worst sufferer in this respect. Next came Papershell and Sultana. While the late bloomers in the peach orchards are the earliest bearers, I find that Commercial and Harriott's Seedling almonds, while flowering far in advance of the rest, are the latest in ripening."

Mr. Hansen also sends the following description of shells and kernels of varieties of almonds observed, season of 1894:

"Drake's Seedling—Shell hard, thick, light-colored, and solid, with many but small perforations. Kernel fills the shell well, does not shrink; brittle flesh, many twins.

"Harriott's Seedling—Shell soft, thick, many and large perforations; long, slender, of rusty color. Kernel shrinks considerably.

"I X L—Shell hardly soft, much perforated by wide channels, light-colored. Kernel flat, shrinking considerably, not very light-colored.

"King's Softshell—Shell thin, partly adhering to hull, breaking with lightest pressure, rusty-colored. Kernel shrinks but little, flat, dark-colored.

"Languedoc—Shell very light-colored, hard but not solid; well perforated. Kernel shrinks, dark colored.

"Marie Dupreys—Shell very large, coarse, not light-colored, not soft, though almost crumbling under pressure. Kernel shrinking, very large and flat, very dark.

"Nonpareil—Shell coarse and friable. Kernel good size, shrinking, fair color; twins not uncommon.

"Papershell—Shell remains half attached to hull, leaving an unperforated, paper-like hull, which breaks while being handled; color fairly light. Kernel large, shrinking, but darker than shell.

"Pistache—Shell small, roundish, not soft, well perforated; greyish in color. Kernel solid, almost without shrinking, light-colored; many twins.

"Routier's Twin—Shell very round and full, of smooth, almost varnished appearance, and hard; very few, but deep perforations; fairly light-colored. Kernel large, shrinking, dull-colored; twins the rule.

"Sultana—Shell very coarse, flaky, soft. Kernel large, but shriveling rapidly, and dark. Crop too much injured by frost to serve for description.

"Texan Prolific—Shell hard, but well perforated, and somewhat flaky; light-colored, of almost varnished appearance. Kernel rather undersized, shrinking, dark-colored; almost all twins.

"On the smaller trees the blossoms were removed to benefit the growth. On the following only a few fruits were left:

"Flat-Fruited—Shell light-colored, of satin-like surface, few and small perforations, solid and hard. Kernel small and dark. Ripe September 21st.

"Lewelling's Prolific—Shell hard, with but few deep perforations, not dark-colored. Kernel light yellow, shrinking but little; many twins. Ripe August 31st.

"Ne Plus Ultra—Shell not very hard, well perforated, long in shape, and light-colored. Kernel a trifle undersized, shrinking much, dark; many twins. Ripe September 20th."

Merchantable almonds, of the ordinary market varieties, usually run from 160 to 190 per pound. King's Softshell, which was 280 to the pound at the Foothill Station, runs 183 in ordinary lots, when valley-grown. Evidently irrigation will be necessary another season with such varieties, to aid size and quantity. If judicious irrigation does not help them, the almond is evidently an unprofitable fruit in this locality, for six-year-old trees should bear thirty or forty pounds apiece.

Figs.—The season of 1894 was early with all fruits, particularly with the figs. The trees showed leaves from fifteen to thirty days sooner than in 1893. Compare with the following tables these items from 1893 statistics: Ladora showed leaves April 20th; Pasteliere, April 21st; Black Marseilles, Brown Ischia, and Ronde Violette Hâtive, April 23d; Negra Larga, April 30th; Dorée Narbus, May 1st.

Some varieties always retain their foliage much later than others. In 1893, Abondance Précoce, Dalmatian, Black Dattato, Du Roi, Ronde Noir, Sanvito, Trojano, and Brianzola still carried a few leaves on New Year's Day. In the table for the present season, those marked "foliage frozen" retained their leaves until the heavy frost of November 20th. In most cases the growth of new wood was less than during the previous season. Pruning was omitted, so as to allow a more perfect development of the natural fruiting system. Many good authorities never prune the fig at all after it begins to bear, but some varieties appear to require it.

Mr. Hansen writes: "Looking at the extreme types of growth, among the figs, it is obvious that we have to deal with one class lengthening, like the White Adriatic, and another like Du Roi. Both, of course, have the summer growth; but while the former class shows very little tendency to branch, and therefore only adds to the length of already established limbs, the latter lengthens by lateral buds and furnishes additional spurs for the fruit, which is formed in the shape of pea-sized knots, as soon as the wood has sufficiently matured."

THE FIG AVENUES.—TABLE I.

AGE OF TREES, SOIL, FOLIAGE, AND GROWTH STATISTICS.

Variety.	Age.	Soil.	Foliage.		Growth.	
			First.	Frosted.	Summer.	Total.
					Inches.	Inches.
Abondance Précoce	6	Red	April 8	---------	5	12
Agen	6	Granite	April 3	---------	6	12
Angelique	6	Mixed	Mar. 31	Nov. 30	---------	24
Black Bourjassotte	6	Granite	April 4	---------	1	12
Black California	6	Mixed	April 4	---------	---------	24
Black Dattato	3	Mixed	Mar. 31	Nov. 30	---------	18
Black Ischia	6	Granite	April 1	---------	Died August 20.	
Black Marseilles	6	Red	April 2	Nov. 30	8	24
Bourjassotte Gris	6	Red	April 3	Nov. 30	8	18
Breba	6	Red	April 6	Nov. 30	---------	30
Breba	5	Granite	April 5	Nov. 30	---------	24
Brown Ischia	6	Red	Mar. 30	---------	5	12
Brown Turkey	6	Red	April 4	Nov. 30	---------	12
Brianzola	3	Red	April 3	Nov. 30	---------	24
Brogiotto, black	2	Nursery	---------	---------	---------	---------
Brunswick	6	Red	April 3	---------	4	12
Brunswick	6	Granite	April 2	---------	---------	12
Cernica	6	Red	April 2	Nov. 30	6	12
Col di Signora Bianca	6	Red	April 4	---------	---------	18
Col di Signora Nero	6	Granite	April 2	---------	---------	24
Dalmatino	3	Red	April 2	Nov. 30	---------	24
Dalmatian	6	Red	Tree is dying.			
De Constantine	6	Red	April 6	Nov. 20	6	18
Dorée Narbus	6	Granite	April 7	---------	3	12
Drap d'Or	6	Mixed	April 1	Nov. 20	---------	18
Du Roi	6	Red	April 7	Nov. 30	2	12
Early Violet	6	Mixed	April 7	---------	1	12
Gros Gris Bifere	6	Red	April 5	---------	---------	20
Guiglione	3	Mixed	April 3	Nov. 30	---------	18
Hirtu du Japon	6	Mixed	April 6	---------	---------	12

THE FIG AVENUES.—TABLE I—Continued.

Variety.	Age.	Soil.	Foliage.		Growth.	
			First.	Frosted.	Summer.	Total.
					Inches.	Inches.
Kargigna	6	Red	April 3			24
Kargigna	6	Granite	April 2			18
Ladora	6	Red	April 1			12
Monaca Bianca	6	Red	April 1	Nov. 30	12	24
Negra Larga	6	Granite	April 1			20
Osborne Prolific	6	Granite	April 5			20
Pasteliere	6	Red	April 5			12
Petrovaca	6	Red	April 6	Nov. 30	4	12
Petrovaca	4	Red	April 7		18	36
Rocardi	6	Red	April 3		10	24
Ronde Noir	6	Red	April 2	Nov. 30		24
Ronde Violette Hâtive	6	Granite	April 4		Killed by	gophers.
Rubado	5	Red	April 4		10	12
San Pedro	6	Granite	April 8			18
San Piero	3	Red	April 1	Nov. 30		18
Sanvito	3	Granite	April 5	Nov. 30	14	36
Smyrna I.	6	Granite	April 3			24
Smyrna, "Bulletin"	6	Mixed	April 1	Nov. 30		24
Trojano	3	Red	April 5	Nov. 30		36
White Adriatic	6	Red	April 2	Nov. 30		24
White Dattato	3	Mixed	April 3			24
White Bourjassotte	6	Red	April 1	Nov. 30	8	24
White Genoa	6	Red	April 3	Nov. 30		12
White Marseilles	6	Red	April 3			12
Zimeia	6	Red	April 5	Nov. 20	12	24

Though the time when different varieties ripen varies much less than the time of leafing, there was an average advance of fully ten days this season. Zimeia, summer-pruned in 1893, bore well, for the first time, on the old wood.

In the following table, the ordinary division of fig crops into first, second, and third, has been changed to early, middle, and winter. The second, or middle, crop is everywhere the main crop; the third, varying with varieties and location, has practically no value at the Foothill Station, where the second crop is really the last. If the season were longer, the few half-grown fruits that remain on the trees after the leaves fall would ripen, and when the trees are older, some will probably do so on the varieties that hold their leaves longest. The fruits of the early crop are much larger than those of the later crop. The effect of moderate irrigation upon the relative size and value of these fig crops is next to be determined. The column relating to fruitage, headed "Set for Spring," is of course important, as indicating the following season's early crop, and as affording some data respecting the varieties that might serve to receive the Blastophaga insect. Two or three varieties, while setting early fruits and middle-crop fruits, ripen both at nearly the same time. Several are notable for their long and continuous fruiting season, an advantage for the home orchard.

THE FIG AVENUES.—TABLE II. (FRUITAGE STATISTICS. THE EARLY, MIDDLE, WINTER, AND "SET FOR SPRING" CROPS.)

Variety.	Early Crop.		Middle Crop.			Winter Crop.	Set for Spring.
	Pea-Size.	Ripened.	Pea-Size.	Season.	Notes.		
Abondance Précoce	May 12	Fruit dropped	July 5	Aug. 30, Oct. 7	Large crop	Abundant.	Abundant.
Agen	None		June 22	Fruit dropped		30	Abundant.
Angelique	April 4	Fruit dropped	June 26	Sept. 5–20	Small crop	3	
Black Bourjassotte	April 2	Fruit dropped	June 22	Aug. 22, Oct. 15	Heavy crop	36	Abundant.
Black Marseilles	Mar. 31	Aug. 20	Continues to	ripen till frost.		Abundant.	Abundant.
Bourjassotte Gris	April 1	Fruit dropped	June 20	Sept. 2, Oct. 2	Fair crop	None.	Abundant.
Breba	April 5	Fruit dropped	July 5	Fruit dropped		None.	Abundant.
Breba	April 2	Fruit dropped	July 5	Fruit dropped		None.	Abundant.
Black Ischia	Mar. 29	July 15	June 14		Tree died		
Brown Ischia	Mar. 29	July 20	Continues to	ripen till frost.		Abundant.	Abundant.
Brown Turkey	April 1	Fruit dropped	July 8	Sept. 7–20	Fair crop	None.	Abundant.
Brianzola	April 2	Fruit dropped	June 19	Sept. 9–23	Fair crop	None.	Good.
Brunswick	April 3	Fruit dropped	July 5	Aug. 20, Sept. 18	Fair crop	None.	Good.
Brunswick	Mar. 31	Fruit dropped	July 5	Aug. 16, Sept. 18	Fair crop	None.	Good.
Cernica	April 5		Aug. 6	Sept. 6–28	One crop	None.	Good.
Col di Signora Bianca	April 3	Fruit dropped	June 25	Aug. 26, Sept. 21	Fair crop	None.	
Col di Signora Nero	April 5	Fruit dropped	June 27	Sept. 9–17	Small crop	18	Fair.
De Constantine	April 1	Fruit dropped	June 22	Aug. 26, Sept. 27	Fair crop	None.	Fair.
Dorée Narbus	April 3	Fruit dropped	July 5	Aug. 16, Sept. 22		None.	Fair.
Drap d'Or	April 1	One crop	None	Aug. 12, Sept. 6	Heavy yield	None.	Fair.
Du Roi	April 2	July 2	June 21	Aug. 8, Oct. 7	Heavy yield	None.	
Early Violet	April 3	July 8	June 26	Aug. 10, Sept. 30	Heavy yield	None.	Good.
Gros Gris Bifere	April 2	Fruit dropped	July 2	Sept. 9–24	Small yield	24	Fair.
Hirtu du Japon	None		June 18	Aug. 20, Oct. 1	Heavy yield	None.	
Kargigna	April 1	Fruit dropped	June 20	Sept. 2–20	Few	None.	Fair.
Kargigna	April 1	Fruit dropped	June 15	Aug. 26, Sept. 17	Few	None.	Fair.
Ladora	Mar. 29	Fruit dropped	June 20	Aug. 29, Sept. 14	Few	None.	Fair.
Monaca Bianca	Mar. 31	One crop	June 17	Aug. 31, Oct. 17	Heavy crop	Good.	Good.
Negra Larga	April 3	Fruit dropped	June 20	Aug. 20, Sept. 24	Fair crop	2	Good.
Osborne Prolific	April 8	Fruit dropped	June 15	Aug. 27, Sept. 18	Fair crop		Fair.
Pasteliere	Mar. 31	Fruit dropped	June 7	Aug. 10, Sept. 9	Good crop		Fair.
Petrovaca	April 3	July 15	June 16	Fruit fell			Fair.
Rocardi	April 12	Fruit dropped	June 24	Sept. 3–27	Small crop	28	Fair.
Ronde Noir	Mar. 31	Fruit dropped	June 10	Aug. 24, Sept. 19	Large crop		Fair.
Ronde Violette Hâtive	April 3	July 15	June 15		Tree died		
Rubado	Mar. 31	Fruit dropped	June 20	Aug. 26	Very few		Fair.

Smyrna, I	April 6	Fruit dropped	June 27	Sept. 4-20	Very few		Fair
Smyrna, "Bulletin"	None		June 22	Fruit dropped			
Trojano	April 2	Fruit dropped	June 27	Sept. 9	Very few		Fair.
White Adriatic	None		June 20	Aug. 24, Sept. 26	Large crop		
White Dattato	April 4	Fruit dropped	June 12	Fruit dropped			Fair.
White Bourjassotte	April 2	July 15	June 20	Fruit dropped			Fair.
White Genoa	April 1	Fruit dropped	July 3	Aug. 26, Sept. 16	Fair crop		Fair.
White Marseilles	April 2	July 10	June 27	The crop picked	to aid tree.		
Zimeia	April 2	Fruit dropped	June 27	Sept. 12-30	Fair crop		Fair.

The following notes upon some varieties complete the fig record for the season of 1894:

Black Ischia—Tree died August 20th; cause unknown, Fruit at all the Stations has been small and poor, with tough skin; and the variety is only valuable in a collection.

The Black California tree has never done well at Amador Station. The foliage shows a fungoid disease. The same trouble appears on Early Violet, Kargigna, Brown Ischia, White Bourjassotte, and some others. Osborne Prolific showed the disease on both leaves and fruit.

Cernica ripened but one crop, although the fruit set repeatedly.

Col di Signora Bianca, like Black Ischia, is very poor in quality.

Dorée Narbus and Drap d'Or are especial favorites of the birds.

Du Roi, like White Marseilles, appears to set and ripen fruit nearly continuously through the season. The winter crop is far larger than the middle crop, and if the climate permitted, this variety could be depended upon as a third-crop fig.

Hirtu du Japon, as in 1893, bore heavily, and gave entire satisfaction.

Petrovaca is another of the figs that drops its fruit badly when it is half grown.

Ronde Violette Hâtive, a good six-year-old tree, was destroyed, probably by a gopher, the bark being eaten off underground. This is an early fruit, very large, and of excellent quality.

Zimeia fruited for the first time, a small, white, pear-shaped fig, decidedly inferior.

Mr. Hansen gives some further details about the size of the early-crop figs of some varieties: "Brown Ischia, which heretofore never developed an early crop, the terminal buds having been removed by pruning, brought a large crop of fruit, of which the best weighed three, and the smallest four to a pound. Specimens of Black Ischia measured seven and a half inches by five inches. Petrovaca measured seven by seven and a half inches. Ronde Violette Hâtive and White Bourjassotte were nearly as large. While it is not usually possible to note any great difference in the sizes of fruits of the same crop and on the same tree, Monaca Bianca has shown a pronounced difference. The tree is healthy, and there is no reason why fruits ripening side by side should vary in size, as they do, as much as one half. Pasteliere and Drap d'Or are the only figs which ripen their crops early without setting a new supply for the second crop. Both are excellent varieties."

Peaches.—The peach orchard, always a most attractive study, increases in importance year after year. Since, from lack of space, it is impossible to repeat the culture notes of former reports, excepting in a few necessary particulars, the comparison of each chapter relating to Station orchards, with the corresponding chapters heretofore published, will often be found useful. As far as practicable, however, each year's report is made complete in itself.

On the whole, the flowering and fruiting seasons were earlier in 1894 than in 1893—about a week earlier in respect to flowering, and possibly ten days in respect to fruiting, but there are many exceptions to this principle.

The following comparative table of three varieties, extended from a former report, shows some of these fluctuations, whose causes must be looked for in the meteorological peculiarities of the seasons:

Variety.	Bloomed.			Ripened Fruit. (Date, and Time Required.)		
	1892.	1893.	1894.	1892.	1893.	1894.
Chinese Cling	Mar. 8	April 7	Mar. 20	Aug. 17 163 days	Aug. 24 139 days	Aug. 24 157 days
Nichol's Orange	Mar. 8	April 11	Mar. 22	Sept. 4 191 days	Sept. 10 152 days	Sept. 8 170 days
Jennie Worthen	Mar. 21	April 14	Mar. 26	July 7 109 days	July 13 90 days	June 29 95 days

The season was in many respects a hard one. A drought, beginning immediately before the tree-buds opened, and continuing to the middle of May, made it hard to work the orchard. Still the crop was a fair one, and the fruit was as large as could be expected for non-irrigated peaches. Specimens of these hill-side fruits were received at the Central Station, and though undersized throughout, the firmness and delicious flavor of the mountain product somewhat compensates for this commercial defect. The moderate use of water another season will increase the size, without causing appreciable loss in other directions. By more thorough cultivation of the orchard, and by thinning three weeks earlier than in 1892, the size of the peaches has already been improved.

The first table given below shows the age of the trees, the varieties, time of blossoming, and leafage—the epitome, so to speak, of springtide in the Amador peach orchards. Respecting color of flesh, *w* stands for white, *r* for red, and *y* for yellow; respecting consistency of flesh, *c* stands for cling, *f* for freestone, and *cf* for half cling:

PEACH STATISTICS.—TABLE I.

SHOWING AGE OF TREES, VARIETIES, FOLIAGE, AND BLOOM.

Variety.	Age.	Foliage.		Bloom.		Bloom Compared with 1893.
		First.	Full.	First.	Full.	
Alexander, cf, w	6	Apr. 5	Apr. 11	Mar. 30	Apr. 2	Earlier 5 days.
Amsden's June, cf, w	6	Apr. 4	Apr. 12	Mar. 26	Apr. 1	Earlier 6 days.
Albright, c, y	6	Apr. 1	Apr. 7	Mar. 25	Mar. 31	Earlier 4 days.
Beer's Smock, f, y	6	Apr. 3	Apr. 8	Mar. 26	Mar. 31	Similar.
Bilyeu's Late, f, w	6	Apr. 4	Apr. 10	Mar. 20	Mar. 30	Earlier 6 days.
Bonanza, f, w	6	Apr. 1	Apr. 11	Mar. 26	Mar. 31	Earlier 2 days.
Brandywine, f, y	6	Apr. 1	Apr. 5	Mar. 26	Mar. 30	Similar.
Briggs' May, cf, w	6	Apr. 4	Apr. 13	Mar. 28	Apr. 2	Earlier 4 days.
California, c, y	6	Apr. 1	Apr. 9	Mar. 24	Mar. 31	Earlier 6 days.
Chinese, c, y	6	Mar. 31	Apr. 6	Mar. 20	Mar. 26	Earlier 5 days.
Columbia, f, r	6	Apr. 3	Apr. 10	Mar. 30	Apr. 3	Identical.
Cooledge's Favorite, f, w	6	Apr. 2	Apr. 10	Mar. 19	Mar. 23	Earlier 8 days.
Crawford's Early, f, y	6	Apr. 1	Apr. 9	Mar. 25	Mar. 29	Earlier 4 days.
Crawford's Late, f, y	6	Apr. 1	Apr. 8	Mar. 24	Mar. 27	Earlier 5 days.
Crimson Beauty, c, w	6	Apr. 1	Apr. 10	Mar. 24	Mar. 30	Earlier 5 days.
Early Rivers, f, y	6	Apr. 1	Apr. 8	Mar. 20	Mar. 24	Earlier 6 days.
Early Rose, f, w	5	Apr. 1	Apr. 8	Mar. 19	Mar. 23	Earlier 10 days.
Elberta, f, y	6	Apr. 1	Apr. 8	Mar. 24	Mar. 29	Earlier 2 days.
Foster, f, y	6	Apr. 2	Apr. 9	Mar. 25	Mar. 30	Earlier 4 days.
Garey's Hold On, f, y	6	Apr. 2	Apr. 10	Mar. 26	Mar. 30	Earlier 3 days.
General Bidwell, f, w	6	Apr. 2	Apr. 9	Mar. 27	Apr. 1	Similar.

PEACH STATISTICS.—TABLE I—Continued.

Variety.	Age.	Foliage.		Bloom.		Bloom Compared with 1893.
		First.	Full.	First.	Full.	
George's Late, c, w	6	Apr. 2	Apr. 10	Mar. 25	Mar. 30	Earlier 4 days.
Governor Garland, c, w	6	Apr. 4	Apr. 12	Mar. 27	Apr. 2	Earlier 4 days.
Grosse Mignonne, f, w	6	Apr. 2	Apr. 13	Mar. 27	Apr. 1	Earlier 2 days.
Grover Cleveland, c, y	5	Apr. 2	Apr. 9	Mar. 29	Apr. 2	Earlier 1 day.
Hale's Early, f, w	6	Apr. 3	Apr. 9	Mar. 26	Mar. 31	Earlier 8 days.
Heath, c, w	6	Apr. 1	Apr. 7	Mar. 24	Mar. 30	Earlier 7 days.
Henrietta, c, y	6	Apr. 2	Apr. 8	Mar. 26	Mar. 31	Earlier 5 days.
Honest Abe, f, y	6	Apr. 4	Apr. 11	Mar. 24	Mar. 30	Earlier 6 days.
Honey, c, w	6	Apr. 2	Apr. 8	Mar. 23	Mar. 28	Earlier 3 days.
Indian, c, r	6	Apr. 3	Apr. 10	Mar. 26	Apr. 1	Earlier 2 days.
Jacque's Rareripe, f, w	5	Apr. 2	Apr. 10	Mar. 26	Apr. 2	Similar.
Jennie Worthen, cf, y	6	Apr. 4	Apr. 10	Mar. 26	Apr. 1	Earlier 8 days.
Large Early York, f, w	6	Apr. 2	Apr. 11	Mar. 23	Mar. 26	Similar.
Large White Cling, c, w	6	Apr. 1	Apr. 7	Mar. 25	Mar. 31	Earlier 5 days.
La Grange, f, w	5	Apr. 1	Apr. 9	Mar. 26	Mar. 29	Similar.
Late Admirable, f, w	6	Apr. 4	Apr. 10	Mar. 20	Mar. 30	Earlier 7 days.
Lemon, c, y	6	Apr. 1	Apr. 12	Mar. 29	Apr. 2	Earlier 3 days.
Lovell, f, y	6	Apr. 1	Apr. 9	Mar. 19	Mar. 24	Earlier 11 days.
Mary's Choice, f, y	6	Apr. 1	Apr. 10	Mar. 26	Apr. 1	Earlier 5 days.
McKevitt, c, w	5	Apr. 1	Apr. 9	Mar. 25	Mar. 31	Similar.
Morris, f, w	6	Apr. 3	Apr. 13	Mar. 28	Apr. 2	Earlier 2 days.
Mountain Rose, f, w	5	Apr. 2	Apr. 12	Mar. 27	Apr. 2	Similar.
Mrs. Brett, f, w	6	Mar. 30	Apr. 6	Mar. 20	Mar. 26	Earlier 8 days.
Muir, f, y	6	Apr. 3	Apr. 11	Mar. 27	Apr. 2	Earlier 2 days.
Newhall, f, y	6	Apr. 1	Apr. 8	Mar. 22	Mar. 28	Earlier 7 days.
Newington, c, w	6	Apr. 1	Apr. 8	Mar. 24	Mar. 29	Earlier 7 days.
Nichols' Orange, c, y	6	Apr. 1	Apr. 9	Mar. 22	Mar. 30	Earlier 8 days.
Noblesse, f, w	6	Apr. 5	Apr. 13	Mar. 27	Apr. 3	Earlier 7 days.
Oldmixon, c, w	6	Apr. 2	Apr. 10	Mar. 18	Mar. 23	Earlier 10 days.
Oldmixon, f, w	6	Apr. 1	Apr. 7	Mar. 26	Apr. 2	Earlier 4 days.
Picquet's Late, f, y	6	Apr. 1	Apr. 10	Mar. 26	Apr. 1	Earlier 4 days.
Richmond, f, y	5	Apr. 1	Apr. 6	Mar. 25	Mar. 29	Similar.
Royal George, f, w	6	Apr. 3	Apr. 12	Mar. 24	Apr. 1	Earlier 6 days.
Runyon's Orange, c, y	6	Apr. 3	Apr. 10	Mar. 26	Mar. 31	Earlier 4 days.
Salway, f, y	6	Apr. 3	Apr. 9	Mar. 27	Apr. 1	Earlier 2 days.
Seller's, c, y	6	Apr. 1	Apr. 8	Mar. 26	Mar. 30	Earlier 4 days.
Schumacker, c, w	6	Apr. 3	Apr. 9	Mar. 26	Apr. 1	Earlier 5 days.
Smock's Late, f, y	6	Apr. 4	Apr. 10	Mar. 29	Apr. 2	Earlier 7 days.
Strawberry, f, w	6	Apr. 1	Apr. 9	Mar. 30	Apr. 2	Similar.
Stump the World, f, w	6	Mar. 30	Apr. 6	Mar. 20	Mar. 26	Earlier 6 days.
Susquehanna, f, y	6	Mar. 31	Apr. 7	Mar. 24	Mar. 29	Earlier 5 days.
Thissell's, f, w	6	Apr. 1	Apr. 8	Mar. 25	Mar. 30	Earlier 5 days.
Tuscany, c, y	6	Apr. 1	Apr. 9	Mar. 24	Mar. 31	Earlier 5 days.
Ulatis, cf, w	6	Apr. 4	Apr. 11	Mar. 26	Apr. 3	Earlier 7 days.
Ward's Late, f, w	6	Apr. 3	Apr. 12	Mar. 25	Mar. 29	Similar.
Waterloo, cf, w	6	Apr. 4	Apr. 10	Mar. 27	Apr. 1	Earlier 3 days.
Wheatland, f, y	6	Apr. 1	Apr. 9	Mar. 23	Mar. 28	Earlier 6 days.
White Melocoton, f, w	4	Apr. 2	Apr. 6	Mar. 28	Apr. 2	Earlier 7 days.
Wilkins, c, w	6	Apr. 3	Apr. 9	Mar. 30	Apr. 3	Similar.
Yellow St. John, f, y	4	Apr. 5	Apr. 12	Mar. 29	Apr. 2	Similar.

Decidedly the most interesting feature of this table is the column showing time of bloom as compared with 1893. While a few varieties show no change, nearly all are from one to eleven days earlier. But a reference to Table II, which follows, shows that not only did some fruits ripen from one to twenty-one days earlier in 1894 than in 1893, but also that a few were from three to seven days later. In other words, some varieties shortened their ripening season, comparatively speaking, while others lengthened it, and the extremes of variation were fully three weeks apart.

The second table, therefore, shows fruitage, time of ripening, yield, etc., and affords opportunity for comparison with the growth of peaches elsewhere:

PEACH STATISTICS.—TABLE II.

SHOWING FRUITAGE, TIME OF RIPENING, YIELD, ETC.

Variety.	First Ripe.	Last Ripe.	Number.	Weight, in Pounds.	Fruits per Pound.	Season Compared with 1893.
Alexander	June 26	July 1	79	17	4½	Earlier 11 days.
Amsden's June	June 27	July 2	61	12	5½	Earlier 15 days.
Albright	Sept. 6	Sept. 11	195	65	3	Earlier 5 days.
Beer's Smock	Sept. 30	Oct. 11	301	67	4½	Identical.
Bilyeu's Late	Oct. 26	Nov. 2	57	12	4½	Earlier 3 days.
Bonanza	Oct. 12	Oct. 20	61	15	4	Earlier 10 days.
Brandywine	Sept. 6	Sept. 9	41	14	3	Identical.
Briggs' May	June 28	July 2	64	16	4	Earlier 10 days.
California	Aug. 28	Sept. 9	320	80	4	Earlier 12 days.
Chinese Cling	Aug. 24	Sept. 1	55	18	3+	Later 6 days.
Columbia	Sept. 17	Sept. 24	396	100	—4	Later 3 days.
Cooledge's Favorite	Aug. 9	Aug. 13	61	14	4½	Earlier 5 days.
Crawford's Early	Aug. 8	Aug. 16	172	50	3½	Earlier 6 days.
Crawford's Late	Sept. 5	Sept. 10	174	50	3½	Later 6 days.
Crimson Beauty	Oct. 6	Oct. 12	159	45	3½	Earlier 9 days.
Early Rivers	July 8	July 16	249	64	3¾	Earlier 12 days.
Early Rose	July 26	Aug. 1	79	12	6½	Earlier 18 days.
Elberta	Aug. 24	Aug. 30	141	40	3½	Earlier 1 day.
Foster	Aug. 14	Aug. 17	53	13	4	Identical.
Garey's Hold On	Sept. 24	Oct. 3	189	54	3½	Earlier 4 days.
George's Late	Oct. 8	Oct. 17	100	25	4	Earlier 2 days.
Governor Garland	July 3	July 8	117	29	4	Earlier 7 days.
Grosse Mignonne	Aug. 15	Aug. 21	169	37	4½	Earlier 8 days.
Grover Cleveland	Sept. 7	Sept. 14	156	39	4	Later 3 days.
Hale's Early	July 16	July 24	64	14	4½	Earlier 14 days.
Heath Cling	Oct. 3	Oct. 7	87	22	4	Earlier 21 days.
Henrietta	Oct. 4	Oct. 10	187	62	3	Later 2 days.
Honest Abe	Sept. 3	Sept. 14	178	51	3½	Earlier 7 days.
Honey Cling	Aug. 29	Sept. 2	207	52	4	Later 4 days.
Indian Blood	Sept. 9	Sept. 18	187	31	6	Earlier 5 days.
Jacque's Rareripe	July 29	No record.	41	10	4	Identical.
Jennie Worthen	June 29	July 3	87	15	6	Earlier 13 days.
Large Early York	Aug. 5	Aug. 11	149	48	3¼	Identical.
Large White Cling	Sept. 3	Sept. 10	86	29	3	Later 7 days.
La Grange	Sept. 23	No record.	57	12	4½	Identical.
Late Admirable	Sept. 6	Sept. 11	84	28	3	Earlier 8 days.
Lemon Cling	Sept. 4	Sept. 12	128	32	4	Earlier 2 days.
Lovell	Sept. 10	Sept. 20	259	66	3¾	Earlier 4 days.
Mary's Choice	Aug. 25	Aug. 30	142	36	4	Later 2 days.
McKevitt's Cling	Sept. 17	No record.	41	12	3½	Identical.
Morris White	Aug. 29	No record.	119	39	3	Earlier 11 days.
Mountain Rose	Aug. 13	Aug. 18	69	17	4	Identical.
Mrs. Brett	Sept. 3	Sept. 7	98	39	2½	Earlier 3 days.
Muir	Aug. 29	Sept. 2	181	51	3½	Identical.
Newhall	Aug. 29	Sept. 4	249	83	3	Earlier 5 days.
Newington Cling	Sept. 12	Sept. 20	203	41	5	Identical.
Nichols' Orange	Sept. 8	Sept. 11	181	45	4	Earlier 1 day.
Noblesse	Aug. 10	Aug. 19	178	44	4	Earlier 14 days.
Oldmixon Cling	Sept. 1	Sept. 9	226	57	4	Earlier 5 days.
Oldmixon Free	Aug. 29	Sept. 3	91	18	5	Earlier 3 days.
Picquet's Late	Sept. 18	Sept. 23	75	16	4½	Later 5 days.
Richmond	Aug. 18	Aug. 24	75	21	3½	Identical.
Royal George	Aug. 12	Aug. 19	216	39	5½	Earlier 10 days.
Runyon's Orange	Sept. 3	Sept. 13	172	60	2¾	Identical.
Salway	Oct. 2	Oct. 9	191	55	3¾	Identical.
Seller's Cling	Sept. 4	Sept. 7	61	20	5	Earlier 1 day.
Schumacker	July 2	July 13	141	41	3¼	Earlier 8 days.
Smock's Late	Sept. 20	Oct. 1	271	55	5	Earlier 10 days.
Strawberry	Aug. 9	Aug. 16	124	31	4	Earlier 12 days.
Stump the World	Sept. 11	Sept. 20	249	50	5	Earlier 3 days.
Susquehanna	Aug. 30	Sept. 4	48	16	3	Earlier 3 days.
Thissell's	Sept. 25	Sept. 30	201	55	3¾	Earlier 2 days.

PEACH STATISTICS.—TABLE II—Continued.

Variety.	First Ripe.	Last Ripe.	Number	Weight in Pounds	Fruits per Pound	Season Compared with 1893.
Tuscany	Aug. 18	Aug. 23	111	34	3¼	Later 4 days.
Ulatis	July 3	July 9	136	34	4	Earlier 12 days.
Ward's Late	Oct. 3	Oct. 7	117	29	4	Identical.
Waterloo	June 29	July 2	36	7	5	Earlier 14 days.
Wheatland	Sept. 1	Sept. 6	149	50	3	Earlier 3 days.
White Melocoton	Sept. 22	No record.	21	5	4	Identical.
Wilkin's Cling	Oct. 4	Oct. 17	269	67	4	Later 3 days.
Yellow St. John	Aug. 18	Aug. 21	52	12	4½	Identical.

In a few cases, these peaches would be called marketable in point of size. Five of the best specimens of Runyon's Orange weighed three pounds, and the average for that variety was a trifle under six ounces. But Runyon's Orange, Nichols' Orange, and similar clings of the heavy yellow type, as grown in the warmer irrigated districts, not necessarily in the valleys, but often in high foothill regions, will weigh sixteen ounces apiece, or even more. Seller's Cling, which, Station-grown, averages one third of a pound, is sometimes even heavier than the above-named varieties. In fact, the large peaches, that is, peaches of the first rank, for shipping and other commercial uses, ought not to weigh less than eight or ten ounces apiece, and from that upward. It is hard to sell clingstones of less than two and a half inches in diameter, or freestones of less than two and a quarter inches. The Station experience may be taken to show that peaches cannot be successfully grown for market on this kind of land without some irrigation, unless a few of the largest and best-flavored varieties are chosen, and unless high-class customers can be secured, willing to pay extra prices for non-irrigated fruit.

In so large a list of peaches, some varieties must be discarded. Early Rivers, Lovell, Honest Abe, and the California Cling show an abnormal number of doubles, and split stones, nearly every year. The very latest kinds, Bonanza, Bilyeu's Late, and General Bidwell, which, in some localities, carry the peach season far into November, usually split open at Amador from the early rains. The unusually heavy rains of 1894 (early October) ruined all the remaining peaches.

Mr. Hansen, who last year offered a selected list of those varieties best adapted for the small planter in the foothills, sends the following revised list, to give a succession of fruit throughout the season:

Early Peaches.	Yellow Clings.	White Clings.	Yellow Frees.	White Frees.
Briggs' May. Gov. Garland.	Tuscany. Nichols'. Runyon's. Albright's. Grover Cleveland. Henrietta. Seller's.	Crimson Beauty. Chinese. Large White. Honey.	Wheatland. Susquehanna. Crawford. Muir. Newhall. Brandywine. Richmond. Salway. Elberta. Foster. Garey's Hold On.	Large Early York. Late Admirable. Morris White. Mrs. Brett. Mountain Rose. Noblesse. Strawberry. Thissell's.

Among the varieties flowering with large, bright blooms, and therefore especially desirable for planting near homes, Mr. Hansen enumerates the following: Waterloo, Chinese Cling, Briggs' May, Jennie Worthen, Indian Blood, Grosse Mignonne, Columbia, Alexander, Schumacker, Royal George, Amsden's June, Governor Garland, Early Rivers, Noblesse, and Ulatis.

Plums and Prunes.—The red soil and granite soil sub-orchards of plums and prunes have now come into more complete bearing, and therefore the season of 1894 gave better results than that of the preceding year, when birds, deer, and other wild creatures completely plundered all but six varieties, viz.: Petite Prune d'Agen, Columbia, McLaughlin, Prince Englebert, Datte de Hongrie, and Victoria. The six trees of these six varieties, each five years old, grown without irrigation, yielded in all ninety-one pounds of fruit.

The following table illustrates the difference between the seasons of 1893 and 1894:

Variety.	First Leaf.		First Flower.		Fruit Ripe.	
	1893.	1894.	1893.	1894.	1893.	1894.
McLaughlin	Apr. 20	Apr. 4	Apr. 19	Mar. 31	Aug. 9	Aug. 3
Victoria	Apr. 20	Apr. 4	Apr. 18	Apr. 2	Sept. 14	Sept. 14
Prune d'Agen	Apr. 18	Apr. 1	Apr. 7	Mar. 28	Sept. 29	Sept. 12
Columbia	Apr. 27	Apr. 7	Apr. 20	Apr. 6	Sept. 14	Sept. 16

The chief advance was in periods of leafing and blossoming; the fruit in many cases did not ripen earlier. As the table shows, the gain in leafage period was from sixteen to twenty days, and in blossoming period from nine to nineteen days. But in respect to fruiting, one variety shows no change, one a loss of two days, and only two show gains of six and seventeen days respectively. The peach shows much more susceptibility to seasonal influences upon early maturity of fruit than does the European plum, but the Oriental plums seem to vary their ripening seasons much more readily. Comparing the flowering season of some other varieties for 1893 and 1894, the following gains were noted in the latter season:

Bavay's Green Gage	Flowered 17 days earlier.
Botan	Flowered 14 days earlier.
Burbank	Flowered from 5 to 9 days earlier.
Damson	Flowered 24 days earlier.
Hungarian Prune	Flowered 20 days earlier.
Kelsey	Flowered 7 days earlier.
Précoce de Bergthold	Flowered 10 days earlier.
Prince Englebert	Flowered 17 days earlier.
Robe de Sergent	Flowered 16 days earlier.
Shropshire Damson	Flowered 18 days earlier.
Winesour	Flowered 10 days earlier.

Over forty varieties of plums and prunes bore fruit sufficient to justify a tabulated report. These varieties, therefore, appear also in the table which follows, giving statistics of foliage and blossom periods:

PLUMS AND PRUNES.—TABLE I.

Foliage, Blossom, Age, and Soil Statistics for the Season of 1894.

Variety.	Age.	Soil.	Foliage.		Blossom.	
			First.	Full.	First.	Full.
Bavay's Green Gage	5	Granite	April 2	April 12	April 1	April 4
Belgian Purple	5	Granite	April 1	April 10	April 1	April 4
Bleeker's Gage	5	Granite	April 3	April 11	Mar. 30	April 3
Blue Damson	6	Red	April 6	April 14	April 2	April 6
Botan	5	Granite	Mar. 28	April 4	Mar. 20	Mar. 26
Brignole	5	Granite	April 3	April 11	April 2	April 8
Bulgarian Prune	6	Red	April 5	April 10	April 4	April 6
Burbank	5	Granite	April 1	April 12	Mar. 26	Mar. 31
Burbank	5	Granite	April 1	April 9	Mar. 25	Mar. 27
Chabot Blood	5	Granite	Mar. 24	April 2	Mar. 18	Mar. 24
Cherry	6	Red	Mar. 22	Mar. 30	Mar. 19	Mar. 24
Coe's Golden Drop	6	Red	April 4	April 10	April 2	April 6
Columbia	6	Red	April 7	April 12	April 6	April 9
Copper	5	Granite	April 3	April 14	Mar. 30	April 2
Damson	6	Red	April 4	April 9	April 2	April 5
Diaprée Rouge	6	Red	April 2	April 10	April 2	April 8
Duane's Purple	6	Red	April 2	April 8	Mar. 26	Mar. 31
Early Golden Drop	5	Granite	April 1	April 10	Mar. 30	April 2
French Prune	6	Red	April 3	April 9	April 1	April 5
French Prune	6	Red	April 1	April 6	Mar. 31	April 4
Hungarian Prune	6	Red	April 6	April 10	April 5	April 8
Imperial Gage	5	Granite	April 2	April 11	Mar. 31	April 2
Ive's Autumn	5	Granite	April 2	April 9	April 2	April 3
Jefferson	6	Red	April 1	April 6	Mar. 26	Mar. 31
Kelsey	5	Granite	Mar. 30	April 4	Mar. 24	Mar. 30
McLaughlin	6	Red	April 3	April 9	Mar. 28	April 4
McLaughlin	6	Red	April 4	April 10	Mar. 31	April 5
Marianna	5	Granite	Mar. 31	April 3	Mar. 29	April 2
Ogon	5	Granite	Mar. 28	April 2	Mar. 18	Mar. 24
Petite Prune d'Agen	6	Red	April 1	April 6	Mar. 28	Mar. 31
Précoce de Bergthold	5	Granite	April 2	April 10	Mar. 31	April 2
Pond's Seedling	5	Granite	April 1	April 9	April 2	April 4
Prince Englebert	6	Red	April 4	April 10	April 3	April 8
Prince Englebert	6	Red	April 4	April 10	April 3	April 7
Prince of Wales	6	Red	April 1	April 7	Mar. 28	April 2
Prince's Yellow Gage	5	Granite	April 2	April 12	Mar. 31	April 2
Quackenboss	6	Red	April 4	April 10	April 3	April 6
Robe de Sergent	5	Granite	April 1	April 9	April 2	April 4
Robe de Sergent	6	Red	April 5	April 9	April 3	April 6
Royal Hâtive	5	Granite	April 1	April 10	April 1	April 4
Shropshire Damson	6	Red	April 5	April 13	April 2	April 7
Shropshire Damson	6	Red	April 5	April 11	April 1	April 6
St. Catherine	6	Red	April 3	April 8	April 3	April 6
St. Lawrence	5	Granite	April 3	April 14	April 2	April 5
Victoria	6	Red	April 4	April 9	April 2	April 5
Victoria	6	Red	April 5	April 10	April 2	April 6
Victoria	6	Red	April 5	April 12	April 3	April 7
Winesour	5	Granite	April 2	April 10	Mar. 31	April 3
Yellow Gage	5	Granite	April 2	April 13	April 1	April 4

In the above table, the Copper plum is of doubtful authenticity, and the variety marked "French Prune," an excellent bearer and choice fruit, differing somewhat from Petite Prune d'Agen, has not yet been determined. All the others appear to be true to name.

Table II gives the crop statistics, and shows some very great differences among varieties. On the whole, the crop borne by the trees is small, but the quality appears to range high, and the size of the individual fruits, in most cases, is very fair. Comparing this table with that of the peach yield, it appears that the plums are somewhat larger in proportion than the bulk of the peaches on this soil without irrigation. Kelsey plum, for instance, runs five to the pound; Pond's Seedling and Prince Englebert run six to the pound. In other words, such varieties as these weigh as much as some excellent varieties of peaches. Still, irrigation is indicated as desirable for the plums as well as for the peaches, in order to secure larger crops, and, in some cases, larger fruit. The foreman writes that the "dying off of branches has been pronounced in a few cases. One large limb of McLaughlin withered during July, and was entirely dead September 1st. The fruit, which had set well on this tree, was brown around the pits." This would seem to indicate the need of irrigation.

PLUMS AND PRUNES.—TABLE II.

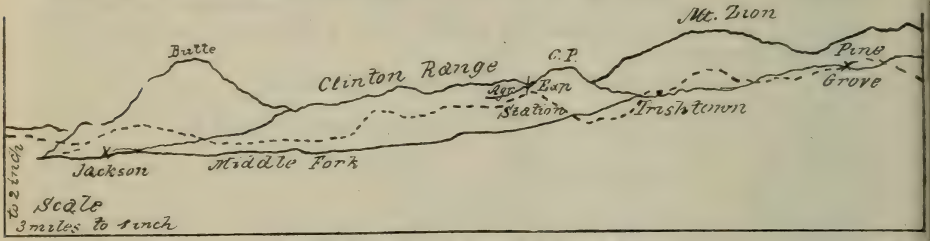
Crop Statistics for 1894—Time of Ripening, Yield, Etc.

Variety.	Thinning Season.		When Ripe.	Yield.		Remarks.
	Taken Off.	Date.		No.	Lbs.	
Bavay's Green Gage	210	June 27.	Oct. 7.	198	16½	Small; very sweet.
Belgian Purple	74	July 20.	Aug. 30.	161	11½	Deep black; dry.
Bleeker's Gage	112	July 12	*	*	*	Gum disease.
Blue Damson	None.		Sept. 29.	327	18+	Jelly plum.
Botan	None.		Aug. 1.	92	11½	Excellent here.
Brignole	None.		Sept. 29.	114	11½	Lacks juice.
Bulgarian Prune	None.		Sept. 20.	301	20+	Exceedingly sweet.
Burbank	1,278 62	May 29. June 16.	Aug. 8.	236	26+	Strong growth; high class plum.
Burbank	176	June 3.	Aug. 28.	141	12¾	
Chabot Blood	None.		Oct. 3.	132	$18\frac{6}{7}$	Flavor resembles gooseberry.
Cherry	None.		July 12.	89	6	Very sweet here.
Coe's Golden Drop	42	July 16.		142	17½	Standard variety.
Columbia	None.		Sept. 16.	183	23	Lacks juice.
Damson	None.		Oct. 14.	757	36	Jelly plum.
Diaprée Rouge	None.		Sept. 6.	182	26	Exceedingly sweet.
Duane's Purple	None.		Sept. 24.	136	15	Some gum disease.
Early Golden Drop	59	June 2.	July 2.	238	15¾	Medium quality.
Hungarian Prune	None.		Sept. 17.	197	18	
Imperial Gage	124	June 19.	Aug. 18.	284	22—	Sweet and solid.
Ive's Autumn	None.		Aug. 15.	12		Resembles Yellow Gage.
Jefferson	50	July 6.	Sept. 3.	93	8½	Excellent.
Kelsey	32	June 10.	Sept. 27.	97	19+	Growth upright.
McLaughlin	46	June 2.	Aug. 8.	153	19	Fair quality.
Marianna	None.		July 18.	219	14½	Astringent.
Ogon	12	July 2.	Sept. 28.	48	8	Resembles Kelsey.
Prune d'Agen	None.		Sept. 12.	242	13½	Very sweet.
Précoce de Bergthold	None.		July 16.	276	9	Good flavor.
Pond's Seedling	None.		Sept. 20.	39	6½	Grosse Prune d'Agen.
Prince Englebert	201 57	June 6. July 5.	Sept. 2.	184	30⅔	Rather dry flesh.
Prince of Wales	None.		Aug. 28.	215	19½	Old; superseded.
Prince's Y. Gage	29	July 8.	Aug. 28.	72	6½	Very dry flesh.
Quackenboss	None.		Sept. 26.	112	10	Firm; dry.
Robe de Sergent	None.		Oct. 4.	171	10	Granite soil.
Robe de Sergent	None.		Sept. 27.	347	23	Red soil.
Shropshire Damson	168	July 5.	Sept. 22.	1,044	29	Jelly plum.
St. Catherine	None.		Sept. 29.	308	15	Very sweet.
St. Lawrence	None.		Aug. 17.	72	9	Granite soil.
Victoria	222	July 5.	Sept. 14.	298	30	Lacks juice.
Winesour	None.		Sept. 7.	119	6½	Of Damson type.
Yellow Gage	None.		Aug. 10.	93	7	High quality.

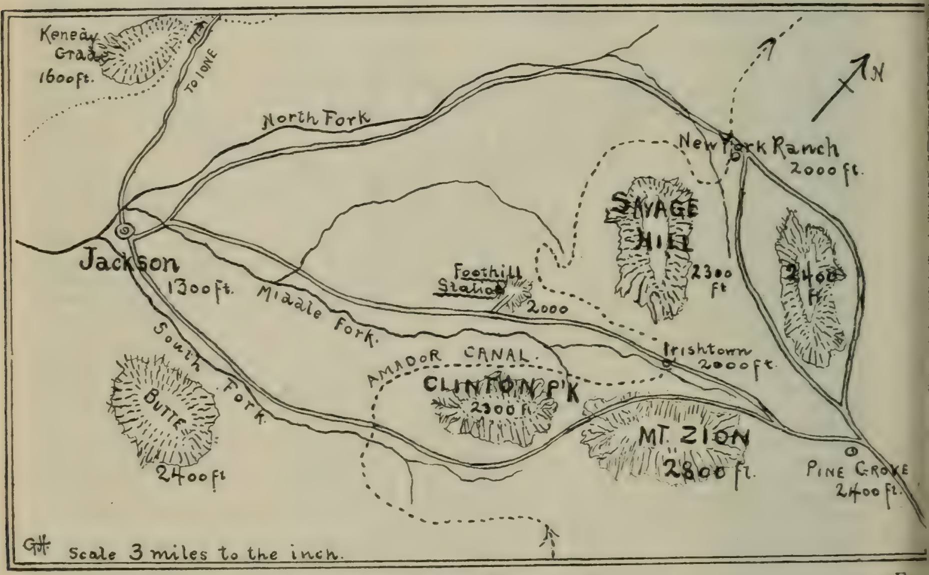
* Fruit picked off August 1st.

CLIMATE OF THE FOOTHILL STATION.

The prominent horticultural districts of the Sierra foothills are mostly situated at altitudes of less than 1,500 feet, and many of them are below the 1200-foot level. It seems to be approximately true that the mean annual temperature of the great central valleys of the State continues eastward into the Sierra foothills to an elevation of from 2,000 to 3,000 feet; but the annual rainfall increases with the elevation. Sacramento, for instance, which is only about 30 feet above the sea-level, has a mean annual temperature of about 60° Fahr., and an average rainfall of about 18 inches. As we go east from Sacramento, we reach Auburn, elevation 1,360 feet, with a mean annual temperature of about 59°, and a rainfall of 30 inches. Still farther east, and higher up the Sierra, Colfax, 2,421 feet above the sea, has an annual mean temperature of 60°, and about 42 inches of annual rainfall. Misleading though such annual mean figures may become, if improperly used, the general law of the Sierra foothill climate is thoroughly well established. It is only



W. PROFILE OF HILLS ALONG MIDDLE FORK. E.



W. LOCATION OF SIERRA FOOTHILL STATION. E.

necessary for the meteorologist to obtain reliable records of changes in temperature and other data from as many localities as possible, to chart out climatic maps full of details of priceless value to the horticulturist.

The Foothill Station does not possess a climate in any way remarkable as compared with numerous localities at similar elevations in the Sierra. It has what is better, a typical foothill situation, surrounded by peaks, ridges, and depressions of greater or less extent, giving it the general characteristics of a so-called "thermal belt," or thermal spot, thousands of which exist undescribed throughout California. The accompanying outline charts, drawn by Mr. Hansen, will more clearly illustrate its surroundings.

Let the reader first note the profile of the hills, from Jackson, the county seat of Amador, 1,300 feet above the sea-level, past the Experiment Station, 2,000 feet elevation, to Pine Grove, ascending nearly east along the Middle Fork of Jackson Creek. The dotted line shows the hill on the right-hand side of the stream. The Butte, Clinton Range, and Mount Zion are all on the left-hand or southern side.

Evidently the Station is on a hill set among larger hills, with stream-drained cañons to retain the colder air, or to carry it past on either hand. The second chart shows this even better, giving the three forks of Jackson Creek, the main county roads, which necessarily follow the passes, and the principal elevations. From Kennedy ridge, 1,600 feet, at the extreme west of the chart, one descends 300 feet to Jackson. The first-comers, new to California conditions, thought that the warmest, most sheltered site in the region must be in the bottom of the Jackson Creek valley, or cañon. Southeast, east, and northeast from Jackson are five prominent peaks from 1,000 to 1,500 feet higher than the town itself. The Experiment Station is 700 feet above Jackson, so that these hills are considerably higher than the Station. Amador Canal curves downward from the headwaters of the Mokelumne, passes west of Clinton Peak, swings far east so as to cross Middle Fork at the Irishtown level, then runs far west again across the Station tract and a second time east to New York Ranch, so as to cross another fork without much loss of grade. Its grade descends, of course, but one may approximately rate the altitude of this dotted serpentine line on the chart at 1,800 feet, or 500 feet higher than the town of Jackson.

Every one who lives in the mountains, knows that it is far colder along the rivers, and that some places have early autumn frosts and late spring frosts which other places escape. A study of the currents of air will enable one to understand the reasons for these differences.

Mr. Hansen, the foreman, has made continuous observations in this field, and the following pages are largely compiled from his reports sent to the Central Station:

Thermal Belts.—Says Mr. Hansen, explaining local conditions: "The warm air travels from our valleys to the snow-capped Sierra, and the cold air moves from them to the lands below. The path which they travel is varied by every hill and curve in the cañons. Great as the suction may be either way, there is always one region in which the center of motion is located. To the cold wave belongs the night, to the warm wave the day, but at the region where one gives way to the other, a different temperature must originate, a different vegetation occur. Such conditions and circumstances combine to create a thermal belt.

"It would be impossible to locate thermal belts on a map, without visiting the territory. If one is familiar with any county road in the foothills, and remembers which way the dust was carried while driving, at different times of the day, it may help the matter. When near a thermal belt, the dust stays behind while one is driving down-country, up to the middle of the day; but through the afternoon it stays with the team, no matter which way one goes. In the evening, if going down, it follows; but it stays far behind if one travels up-country. But even then one may err, and it is better to consult the vegetation. If thermal belts are favored spots, they must protect tender plants to a higher altitude, and must not allow hardier plants to come down as low as geological conditions would make one infer. The last sturdy representatives of the bull pine (*P. Sabiniana*) are just about where the last warm influence of valley currents extend. The black live oak (*Q. Wislizeni*), the blue oak (*Q. Douglasii*), and the common buckeye (*Æsculus Californica*), also belong here. Of hardier plants, coming down, one easily recognizes the large-leaved maple (*A. macrophyllum*), the ash (*F. Oregana*), and under their shade the prickly gooseberry and the soft-leaved hazel.

"Referring to Amador County, I do not know of any thermal-belt more than 2,000 feet above the sea, but it must be understood that there is no continuous thermal belt over the country. Exchanges of air from cold and warm regions have to take place across such territory, and every cañon must be omitted. Along them flows the cold heavy air from the Sierra, frost-killing whatever is in its path, if too tender for the season. If such cold stream of heavy air is too voluminous, it has to overflow into a side cañon. The space which these cold rivers occupy was previously held by warm air, which was lighter, and had to give way, rising above the level of the cold. Wherever it goes is the warm region, the thermal belt.

"Because of the exchange of mountain and valley air, around and across our hilltops, the Experiment Station does not have a sunless sky more than about forty days in the year. The wide basin, five miles of air-line in extent, spreading from Mount Zion down to the ranges around Sutter Creek and Jackson, is warmed in winter and heated during summer. There is always a breath of air here, even during the hottest spell, though then the valley air is dry, coming over barren hills or the tops of leather-leaved shrubs and trees. So continuous is the air-stream from west to east that the divide between the two highest hills on the Station tract is an airy passage. Every tree there is one-sided or stunted in growth on the windward side. But on cold, windy mornings, a flow of air comes from vast snow fields. Then if the weather-vane turns to the northeast, and keeps there, we have dry spells, which are pretty regular during March, and are very injurious to growing crops.

"To determine how far up and down these changes take place, observations have been kept on the top of the highest Station hill, and also down near the Amador Canal. There is indeed a surprising divergence from month to month, but the means of each year correspond closely. The low ground, near the ditch, is sheltered by the hills, so that a wind which strikes the latter may pass over the quiet air along the ditch, where the thermometer, in consequence, will register, perhaps, 12° higher. It often happens, therefore, that the day's temperature is more agreeable on the tops of the hills than at their bases. But the nights begin much warmer on the hilltop, until cooling breezes come from the mountains. Sometimes, though seldom, the hilltop is cooler during the early night.

"On a frosty night of uncommon severity, without easterly winds, the low ground suffers most, especially in April. The greatest difference between day and night, as registered during five years' observation, has been 13°, sometimes at the low ground, sometimes at the house on the hill.

"Snow, the equalizer of frost, is but little known here. The first winter, 1888–89, brought slight snows, and the wet winter of 1889–90 covered the highest knoll for a few hours about half a dozen times. It is said that snow has fallen in Jackson sufficiently deep to allow sleighing, but I have not seen the hills around it covered more than five times during as many years, and but once was there enough to snowball with.

"The rainfall has been from 25 to 54 inches annually, which is from 5 to 15 inches more than that at Jackson. A very early rain in the fall seems to be followed by a dry, early winter, and in that case rain can be expected during the early part of May. But the late showers sometimes fail, in which case nothing but summer-fallowing will assure a harvest.

"Fogs do not originate here; they are visitors from the valley. They seldom come during the early winter, but appear in February and March. When they come, it is usually in the morning; an hour or so later they sink until they barely cover Jackson, whence they return to their first levels. When rising, the fog fills, with interesting precision, all the low gulches. It travels along the deep cut of the Mokelumne River bed eastward for miles beyond our location. It comes along the South Fork, the Middle Fork, and, lastly, the higher North Fork, and fills, one by one, the side gulches, climbing the zones foot after foot, as its volume increases.

"The thermometer went no lower than 24° during the first five years, but in January, 1894, it registered 22° at the house on the 2d and on the 19th. The thermometer at the Amador Canal, in the meantime, registered 25° on both these occasions, but on the night of the 5th it fell to 21°, while the thermometer at the house registered 29°.

"Thermal belts favor the farmer, because the season of growth is longer than elsewhere. While in early spring the sun warms the low places, and forces vegetation into growth, though it is apt to be frosted, the air in a thermal belt is circulating, and growth advances safely. I have planted Early Rose potatoes the first week of January; peas will bloom all winter; broad beans bear as soon as warm weather comes; onions can be planted any time after October; cabbages will not rot, though they may be snowed on; and carrots are safe in the ground all winter. Corn will be in silk here before it is safe to plant at the ranches below, and tomatoes are red as early as those in the valley, and may be coloring after the valley has no more to show. I have had Extra Early Six-weeks beans in bloom at Christmas time."

Weather Report for One Year.—In order to still further illustrate the climate of the district, Mr. Hansen has sent a weather report, month by month, and portions of his notes are here given, beginning with October, 1893, and ending with December, 1894:

"In 1893 the October rains were very slight, amounting to only half an inch, barely sufficient to lay the dust. It was a pleasant month, damp enough to admit of the burning of brush without danger from fire, and dry enough to give a long season to the mountain teamsters.

"Such weather continued through almost the whole of November, as the first heavy rains did not fall till the last week of that month. The first killing frost of the season came on the 16th. The first northeast storm blew during the middle of the month, but as the ground was not yet dry, no harm was done to the orchard.

"December was normal, excepting the fog, which came earlier in the season than usual. It began on the 12th, and occurred on six different occasions, mostly during the night. It did not extend beyond the comparatively thermal district of the Station. Six frosts fell, the coldest lowering the thermometer to 26° Fahr.

"January brought the roughest weather since the establishment of the Station. The lowest temperature previously reached was 24°, but on the 5th the thermometer at the Amador Canal registered 21°, while the one at the house, 200 feet higher, marked 25°. On the 2d and 18th, 22° was marked at the house, while the instrument at the ditch registered 25° on both occasions. Snow fell on the 2d and 18th, about fourteen inches in all, but melted in twelve hours. Winds from south and southwest were terrific, especially on the 14th and 18th. The rains were very heavy, reaching 3.28 inches on the 15th, and 2.81 inches on the 20th. The total downpour of the month was 9.88 inches. Heavy fogs of the 24th and 27th enveloped the house for the first time since observations were taken here.

"February was worse than the preceding month; similar fogs occurred on the 7th and 21st; snow fell all day of the 9th, melting on the ground, and registered 1.69 inches in the rain-gauge. A hail-storm occurred on the 15th; northerly and easterly winds were frequent, but did not rise to a storm, except during the night of the 21st. The worst rain-storm of the season began on the 18th, lasting fifty-five hours, and 6 inches of rain fell during that time. Total rainfall for the month, 10.84 inches. The lowest temperature was 24°, and fifteen days of killing frost made this the coldest month.

"Fogs from the main valleys usually come during March, but this year only three occurred—on the 1st, 13th, and 30th. Rain was frequent, but only reached a total of 2.52 inches, including a little hail and snow. Nine days of killing frost occurred. Strong winds blew during the first week, and a heavy wind-storm from north and east began on the 17th; continuing for five days. All the moisture contained in the surface of the ground was dried up, and a drought set in, which threatened to destroy the crops.

"April, also, was a dangerously dry month, bringing growth of cereals to a standstill. Two showers of rain gave only 1.38 inches. High winds, mostly from the west, blew for days in succession. The first wind period reached from the 1st to the 6th, the second from the 10th to the 19th, and the third from the 22d to the end of the month. Three killing frosts occurred.

"The usually heavy rain of the first week in May did not begin until the 14th. The total precipitation was 4.15 inches, reviving the stunted grain. Wind prevailed throughout the month, rising to a storm on the 25th. Light fogs occurred on the 3d and 26th. The thermometer twice fell to the freezing point.

"Cloudy days and gentle showers continued through the first week of June. The last shower of the season fell on the 17th; total rainfall, 1.48 inches.

"July and August were much alike, the mean of both months being about 75°. The lowest temperature of the two months was 50°, and the highest was 102°. Hardly any clouds were to be seen. Gentle breezes blew nearly every day from the west.

"September continued much the same as the previous month, except near its close, when unusually cool weather, for the season, lowered the thermometer to 38^c, and brought the first autumn rain on the last day of the month.

"In October the winds had great force, especially on the 7th and 19th. The latter storm continued for several days, and, as an unusually heavy rain set in, the ground became soaked, and the storm tore the fruit trees, especially those that had not yet dropped their foliage. Nearly every one of our figs, as well as many other trees, had to be furnished with extra stakes.

"November was dry and quiet; almost windless and cloudless, compared with the usual November weather.

"December was very severe, there being 15.50 inches of rain during three periods of tempestuous weather. A storm, beginning during the night of the 15th, and continuing till the 19th, brought 6.49 inches of rain."

The following table shows some of the climatic features, as observed at the Foothill Station during three years—1892, 1893, and 1894:

CLIMATE OF FOOTHILL STATION.

	1892.			1893.												1894.								
	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September
Highest temperature—	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
At house	82	70	56	62	59	79	76	84	89	95	97	83	75	64	62	54	58	69	78	86	84	94	96	88
At ditch	84	73	60	63	60	79	71	83	93	97	96	84	74	66	64	55	59	69	79	88	83	93	102	93
Lowest temperature—																								
At house	32	28	24	29	24	26	27	34	38	72	53	54	36	32	26	22	24	22	30	30	36	50	48	38
At ditch	32	30	26	32	26	28	32	38	42	75	54	53	36	30	28	21	27	25	32	32	39	50	50	38
Mean temperature—																								
At house—Maximum	65	58	46	53	49	48	60	69	77	86	86	69	63	55	50	44	45	53	62	62.4	68.2	84.2	83.6	76.2
Minimum	49	45	45	40	34	36	50	48	53	61	62	50	62	60	31	33.5	34	37	44	47.6	47.6	61.4	63	56.2
At ditch—Maximum	67	56	49	54	49	52	59	70	75	87	86	70	64	53	51	45	46	56	67.6	73.3	69.8	88	87.7	81.7
Minimum	48	42	45	38	34	38	40	47	55	59	62	50	44	39	40	33	33	37	42.7	49.4	48.3	58.7	59.3	54
At house	57	52	45	46	42	42	55	59	65	73	74	59	53	41	44	39	45	45	55.1	58	57.9	72.8	73.3	66.2
At ditch	57	49	47	46	42	45	49	59	65	73	74	60	54	46	45	39	39	46	55.1	61.3	59	73.3	73.5	67.8
Differences—																								
Greatest between house and ditch during day	6	8	10	10	7	5	10	4	5	4	4	4	4	5	12	3	6	10	17	12	14	11	7	12
Greatest between house and ditch during night	7	13	8	9	13	6	6	13	8	9	6	8	6	8	3	8	5	8	7	18	8	7	9	8
Between mean maximum at house and ditch	2	2	3	1	0	4	1	1	2	1	0	1	0.6	2	1	1	0.5	1	1.4	3.9	1.6	3.8	4.1	5.5
Between mean minimum at house and ditch	1	3	0	2	0	2	10	1	2	2	0	0	2.5	2	2	0.5	1	0	1.3	1.8	0.7	2.7	3.7	2.2
Between mean at house and at ditch	0	3	2	0	0	3	6	0	0	0	0	1	1.5	2	1.5	0	0.5	1	0	3.3	1.1	0.5	0.2	1.6

REPORT ON THE HAY CROP—FOOTHILL STATION.

By GEORGE HANSEN, Foreman.

Land at the elevation of our Station is not often adapted to the growth of grain. The fields are too much divided by rocks, gulches, and hills to permit the use of gang plows. To harvest grain in such small fields as occur on the ranches here, pays only when an unusually heavy crop warrants the bringing of a threshing-machine from the valley. Some grain is raised every now and then, but such work would never be undertaken if a railroad reached the region. In practice we confine ourselves to the growing of hay, which is a product too bulky to haul far over the wretched roads. The price of alfalfa hay in Ione valley, eighteen miles distant, ranges from $7 to $8 per ton; of barley hay, from $9 to $12, according to the season. The latter kind can be bought at Jackson at from $15 to $16, depending largely on the amount wanted, and the supply on hand. At Pine Grove, four miles above the Station, barley hay cannot be bought for less than $18 in the best season for crops and hauling, whereas during the winter time, when roads are nearly impassable, one has to pay whatever is demanded. The price of hay at the sawmills, twenty or twenty-five miles east, ranges from $20 to $25 per ton. It is hauled there by teams going for lumber.

Hay-growing in our region is still a paying investment, provided that a rancher is settled on cleared ground, which he owns, and that the total year's crop is not too large for the local market.

Summer-fallowed ground is never seeded before the end of November. A sowing into the dust may turn out to be profitable, provided the spring is favorable to the curing of the crop. But if there is danger that repeated showers will wash the cut hay, and that the hot sun will take out the last vestige of flavor, it is wiser to let an early crop stand for threshing, provided the heads appear to guarantee any returns.

Any time from the first of December to the first week of February is right for the sowing of grain for hay in our part of the foothills; but there is danger of heavy rains preventing the working of the ground. A wise rancher, therefore, will not plow more ground than he knows he can put into seed and finished condition before renewed rains render it unfit to step on. But once, since the establishment of the Station, was the winter so continuously wet that it was impossible to put in any seed during the whole of December and January. Seeds put into the ground after the middle of February have sometimes brought good crops, but such delay of the work is too full of risk. It is a fact, though, that seed sown all the way from the first of December till the end of January will vary in the degree of ripeness so little that it is almost impossible to say with certainty when this or that field was seeded; and the mowing machine, once started, is, as a rule, kept busy on fields that may vary in their growing period as much as six or seven weeks.

A perusal of the weather reports, elsewhere printed, demonstrates that the season of 1894 was an unusual one. November, 1893, ended with heavy downpours. December brought fair winter weather and gentle showers. Considerable clearing in the fields had to be done, and seeding was postponed till the beginning of January, 1894. As soon as the weather cleared, after the first rain in that month, all haste was made to put the seed into the ground. Terrific storms from the south and southwest followed immediately, and the downpour of rain was appalling; almost 7½ inches fell during less than seven days. Including 14 inches of snow, there were 9.88 inches for the month. The temperature of February was unfavorable for any growth of grain. The mean of the month was 10° Fahr. below the annual mean, and steady rains of a total of 10.84 inches rendered the month wet and cold. The March rains were unusually gentle, only 2.52 inches falling during the whole of the month, the last trace occurring on the 18th. The dry winds from the east and north, which are the rule in our region during February and March, did not show up during the former month, but came in March in double strength and with blighting effect. It was plain that such weather was not likely to continue for any length of time, and everybody looked for relief from day to day. Plowing in the orchards and vineyards was postponed from week to week. The fields assumed a sad aspect; the hay never stooled well, little as it ever does in our region, after having been frosted and soaked as soon as deposited in the ground.

After that, rain ceased, and the price of hay, left from the previous season, rose to $20 and $22 per ton in Jackson, and parties engaged in stock-raising refused to sell the straw from the threshing. Cattle were taken to the mountains as high as the snow would permit, and were turned loose to find grazing ground wherever the snow thawed. A little shower of 1.38 inches on April 23d did not more than moisten the ground, which had been entirely dried by north and northwest winds. Water from irrigation canals was made use of wherever the lay of the fields would permit, but the failure of crops seemed certain, as no rain came this way. May 14th brought some rains, but still accompanied by drying winds. We have been applying irrigation as much as our limited facilities would permit, but, as this shower fell soon after irrigation had been begun, the effects were not enough to be perceptible. Gentle showers continued through the rest of May, and worked wonders with the stunted growth. The stalks lengthened and, the growth above the ground having been retarded, branched from the roots. Most of the grain became too ripe during these continuous showers, which lasted till June 6th, but it was deemed wiser to let some stalks get too ripe, than to cut down too much at a time, and have it rot on the ground. The last of the oats was cut on June 13th; the accompanying tables show with what results:

TABLE I.—Barley on Granite Soil.

(Sowed January 8th, mowed May 28th; growing period, 139 days. Rainfall, 27.90 inches; plots, one tenth of an acre; 25 lbs. seed sown on each plot.)

Plots.	Fertilizer Applied per Plot.	Hay (pounds per Plot)	Observations on Soil.
1	40 lbs. potash	117	Shaded by trees; soil exceedingly poor.
2	Check-plot	142	But little better than above.
3	50 lbs. bone-flour, 10 lbs. nitrate	330	Fair soil.
4	50 lbs. dried blood, 10 lbs. nitrate	395	Good soil.
5	Check-plot	162	Poor soil.
6	60 lbs. bone-flour	275	Shaded by pines; otherwise fair.
7	50 lbs. dried blood	420	Good soil.
8	50 lbs. Brand "B"	410	Some humus.
9	Check-plot	205	Medium soil; best check-plot.
10	40 lbs. chicken manure	310	Fair soil.
11	50 lbs. bone-flour, 10 lbs. nitrate	400	
12	40 lbs. pigeon manure	318	Fair soil.
13	50 lbs. bone-flour	328	Much better than Plot 6.
14	Check-plot	195	Fair.

Looking at Table I, we find that the average crop of unfertilized granite soil yielded at the rate of about 1,750 pounds of barley per acre. Bone-flour, applied at the rate of 500 pounds to the acre, netted 3,000 pounds of hay. One hundred pounds of nitrate of soda added to the coating of bone-meal, brought an additional crop of 650 pounds of hay. Brand "B," of Newhall's fertilizer, secured a yield of two tons to the acre. Four hundred pounds of potash on a very poor piece of granite soil would have led to a crop of only 1,170 pounds to one acre. Dried blood, 500 pounds to the acre, with an addition of 100 pounds of nitrate of soda, equaled the yield of brand "B," 4,000 pounds of barley hay.

TABLE II.—Barley on Red Soil.

(Sowed January 29th, mowed May 31st; growing period, 119 days; rainfall, 19.09 inches; thirteen plots, size, one tenth of an acre; 25 lbs. seed sown on each plot.)

Plots	Fertilizer Applied per Plot.	Hay (Pounds per Plot)	Observations on Soil.
1	40 lbs. potash	210	Little shaded by pines; fair.
2	Check-plot	172	Fair.
3	50 lbs. dried blood	410	Medium.
4	50 lbs. bone-flour, 10 lbs. nitrate	560	Very good; damp clay.
5	50 lbs. Brand "B"	330	Very good; damp clay.
6	Check-plot	280	Very good; damp clay.
7	60 lbs. bone-flour	405	Very good; damp clay.
8	40 lbs. pigeon manure	230	Very good; damp clay.
9	Check-plot	200	Fair.
10	40 lbs. chicken manure	232	Medium.
11	50 lbs. bone-meal, 10 lbs. nitrate	375	Poor.
12	Check-plot	235	Fair.
13	1½ yds. hog manure	360	Rocky, dry, and warm.

Table II gives the results arrived at with barley on red soil. The yields from the check-plots demonstrate best how much difference there can be in the quality of red soil. The poorest piece, but still on fair red soil, netted 1,720 pounds per acre, whereas another one-tenth-acre plot yielded at the rate of nearly one ton and a half per acre. It should be added, however, that this plot was on the very best red soil within the inclosure and, moreover, favored through the decay and burning of a monstrous oak at the very spot. The average crop per acre from these check-plots would be 2,230 pounds per acre. The three bone-flour plots varied as much as the check-plots. The difference of applying, in one instance, 50 pounds of bone-flour only, in the next 60 pounds, and in a third 50 pounds, with an addition of 10 pounds of nitrate of soda, was, to my belief, not so much the cause of the variance of the yields, as was the original quality of the soils. The average of 4,465 pounds per acre may safely be depended on. Four hundred pounds of potash per acre made 2,100 pounds of hay; 500 pounds of brand "B" yielded 3,300 pounds, while 500 pounds of dried blood gave 4,100 pounds per acre. Fifteen cubic yards of hog manure per acre assured a crop of 3,600 pounds of barley hay to the acre.

TABLE III.—Oats on Granite Soil.

(Sowed January 12th, mowed June 7th; growing period, 153 days; rainfall, 29.04 inches; size of plots, one tenth of an acre; 20 lbs. seed sown on each plot.)

Plots	Fertilizer Applied per Plot.	Hay (Pounds per Plot)	Observations on Soil.
1	Check-plot	160	Fair soil.
2	50 lbs. bone-meal	224	Medium.
3	20 lbs. potash	275	Rich in leaf-mold.
4	50 lbs. Brand "B"	255	Poorer soil.
5	10 lbs. nitrate	270	Damper ground.

TABLE IV.—Oats on Red Soil.

(Sowed January 11th, mowed June 13th; growing period, 160 days; rainfall, 29.04 inches; plots, one tenth of an acre; 20 lbs. seed sown on each plot.)

Plots	Fertilizer Applied per Plot.	Hay (Pounds per Plot)	Observations on Soil.
1	50 lbs. Brand "B"	140	Poorest of red soil.
2	Check-plot	130	But little better.
3	50 lbs. dried blood	180	But little better.
4	Check-plot	140	But little better.
5	40 lbs. potash	120	Poorest of red soil.
6	1½ yds. hog manure	260	Rocky, red soil.

Tables III and IV speak for themselves. I had neither the ground nor the fertilizer left to duplicate the plots. The result can be studied in the tables; though I have to add that the granite soil was of a very high quality through the frequent burning of brush on it, from its low and favorable location, and also from a great deal of leaf-mold deposited on it in previous years.

DISCUSSION OF FOREGOING REPORT.

By Charles H. Shinn.

A comparison of the three tables compiled by Mr. Hansen shows plainly the lines of profitable fertilizing on these soils, despite their great variability. Thirty-eight plots, half on the granite, half on the slate soils, are tabulated. On the granite soil, the four barley check-plots (unfertilized) yielded as follows, in pounds: 142, 162, 205, 195, or an average of 174 pounds. But the average yield of the ten variously fertilized plots was 330⅓ pounds. Here is a direct gain of 94 per cent—the crop was almost doubled upon ten plots, covering exactly an acre. The percentage was also reduced by the fact that plot 1 was such very poor soil that, although it received 40 pounds of potash—which helped the oats decidedly (see plot 3, Table III)—its yield was far below even the poorest of the check-plots.

We are further enabled to note the varied nature of the soil by comparing plots 4 and 7, Table I. Both are characterized by Mr. Hansen as "good soil," by which he means soil which is considered good in the district. But the first plot, with 50 pounds of blood, plus 10 pounds of nitrate, produced nearly 5 per cent less yield than did 15 pounds of blood alone on the second plot. This merely illustrates one side of the difficulty. If several of the plots on the granite soil, being permanently marked, can be tested one season with the same fertilizer, say blood or brand "B," the two which gave best results, we shall have another means of comparison.

On the whole, the soil of fully twelve of the fourteen barley plots which were on the granite land, can be called of medium quality soil for the district. If by using the blood or brand "B," we could bring them up to the average of plots 7 and 8, the average yield of the ten fertilized plots forming an acre would be increased 139 per cent over the yield of the unfertilized check-plots, and bring the mountain farmer the very satisfactory yield of something over two tons to the acre, instead of the half ton per acre to which lack of fertilization and poor tillage too often reduces his returns.

Before leaving the plots of barley on granite soil, plots 3 and 9 should be noted. Though fertilized alike, the yield of the first plot is 17 per cent less than that of the second plot—another illustration of the varied nature of the soil and the impracticability of obtaining identical conditions. Collating them with plot 6 and plot 13, the usefulness of the nitrate is evident. The 10 pounds of this fertilizer added hay at the rate of 600 or 800 pounds to the acre. The nitrate alone, on the oats plot (Table III, plot 5), produced better immediate results than the bone-meal or brand "B." The slower action of both the latter must be taken into consideration.

In general terms, it may be said that nitrogenous fertilizers, such as nitrate, with dried blood and bone-dust (or bone-flour, the latter being quicker in operation), are highly profitable on the granite soil. But, owing to the heavy early rains, it is certain that the nitrate, which was applied too soon to produce its best effect, was washed away, to a considerable extent. Another series of experiments with nitrates, sacrificing one of the poor-soil check-plots, whose normal yield is somewhat fairly determined, will now be necessary.

On the red soil the problem is more difficult. The four check-plots (unfertilized) in the barley tests yielded, respectively, 172, 280, 200, and 235 pounds—an average of 221 pounds. On the poorer red soil, used for the oats test, the average of the two check-plots was only 135 pounds—a surprising difference, notwithstanding the smaller weight of all the oat yields. The variation in all the different plots, caused by changes in soil, is very great. The potash (Table II, plot 1, and Table III, plot 5) is so far below the average of the check-plots that it can be regarded as useless on this soil. Comparing plot 6 and plot 9 (Table II), the soil variation is notable. The amount of fertilizer applied was identical, excepting that the bone-flour was a finer grade; but one plot yielded nearly 50 per cent more than the other—indeed, 560 pounds, or at the rate of over two and three quarters tons per acre, is a remarkable yield, and comparing this plot with plot 7, it seems evident that the nitrate must be credited with not less than 150 pounds increase, or at the rate of three fourths of a ton to the acre. On this basis, $2 worth of nitrate gives the farmer a profit, on this kind of land, of not less than $8. If applied properly, as a top-dressing after the grain is up and the heavy rains are past, 150 pounds of nitrate per acre, costing $4 75, would be profitable to apply, and it might reasonably be expected to add from one ton to one and a half tons per acre to the field crop. But carelessness in application might lead to the entire loss of the nitrate-value.

Of these thirteen test-plots noted in Table II, Nos. 4 to 8, inclusive, marked "very good; damp clay," appear to represent the only portion of the entire area devoted to this experiment, which shows sufficient evenness to permit detailed comparison. A second check-plot on this soil, another season, will greatly aid the determination of results. Nos. 3, 9, 10, and 12 may also be regarded as much alike in character of soil, and results in this series may also be compared with profit; but the check-plots indicate that the natural fertility of these four plots is not less than 40 per cent below that of the five plots previously noted.

The experiment with pigeon manure, chicken manure, and hog manure is only useful as determining the undoubted value to the farmer of whatever manure is produced on his farm, at slight expense. But all such manures vary so much in quality that, without an analysis, it is impossible to compare them directly with bone-dust, nitrate, and other commercial fertilizers.

There can be no doubt, then, that with a proper selection of land and judicious fertilization, hay-growing in the foothills can be made a well-paying business. This is still further shown by the results of hay-raising on a larger scale the past season (spring of 1895). One ton of bone-meal and 200 pounds of nitrate were purchased at a total cost of $35 50. This was applied to nearly eight acres of land, excepting that none was put upon the one-tenth-acre plots. The yield was ten and a half tons of hay. Three tons more was cut from perhaps an acre and a half of summer-fallow, also fertilized. Making due allowance for the light crop on the unfertilized plots, it is estimated that the hay crop was doubled by the use of fertilizer. The expenditure of $35 50 thus, gave extra returns of six and three quarters tons of hay; worth, at the time, $84 37½ in Jackson, and worth to the Station $90 or $95. This should be considered a good profit on the investment.

B. SOUTHERN COAST RANGE CULTURE STATION.

One and a half miles north-northeast from Paso Robles, San Luis Obispo County.

By Charles H. Shinn.

The agricultural problems which are presented at this Station are not surpassed in magnitude, interest, and importance by those of any other of the Experiment Stations of the University. A large part of the twenty acres here consists of very sandy soil, sometimes underlaid by "hardpan"; from which many oak trees were removed before the orchard was planted. The soil on the east side of the Salinas River is almost universally held by the farmers of the county to be much inferior to that of the west side. The rainfall is also less on the east, and the frosts, both early and late, are said to be more severe and more frequent. Hence, it is commonly said, in San Luis Obispo County, that whatever can be made to succeed at the Station will grow anywhere in the county. In other words, the Station, established primarily for the benefit of the poorer soils of the Southern Coast Range, seems to have been placed exactly where, in the end, its successful development will mean the most, and for the largest area of country; but it can only accomplish this by slow, painstaking efforts, and by absolute veracity in its tests and reports. The following notes form a history that cannot but be disappointing, temporarily, to some local readers; but, properly accepted, these orchard and garden experiments will save many a land-owner from serious loss.

The Local Problems.—The chief work of the Station at present, as illustrated in this report, and particularly in the notes upon the orchard, relate (1) to difficulties of soil, and (2) to difficulties of climate. Where soil varies so much in character and depth, uniformity of tree growth is impossible, without long and difficult treatment. Soil fertilization upon some parts of the tract is absolutely necessary before fruit crops of value can be obtained. Especial care is needed to protect the trunks of young trees against the sun, and the greatest skill and local adaptability in summer cultivation, pruning, and general orchard management are essential. Lastly, the early autumn frosts, in many seasons, cut short the growth of vines, and injure a large variety of plants before they are fairly hardened up for the winter. Extreme care in late irrigation, or indeed in all irrigation, would, therefore, be necessary in such localities; but, owing to lack of water, the only irrigation yet done at the Station is in the flower garden. It will now be practicable to apply more water to the nursery and to small fruits.

Lastly, and chiefly, the extremely severe late frosts of March and April greatly narrow the range of profitable fruit-growing, both as to varieties and species. From the experience so far obtained, it will now be necessary to plant a new orchard here, of "iron-clad" fruits, choosing those least susceptible to frost, and to test every available means of orchard protection, by culture or otherwise. Over how large an area of the foothill country in this land of oaks these conditions prevail, we cannot yet say; but probably they are representative of large districts. The problem would only be more difficult if we attempted to conceal the truth, leaving hundreds of land-owners and farmers in similar localities to discover for themselves, at almost endless expense, that these late frosts destroy much of the fruit of ordinary orchard varieties. In place of those varieties which have been found to fail in whole or in part, the Station will in time be able to recommend others more hardy, or better fitted by their blooming periods, to set their crops. Specialized methods of culture and pruning must be of service here, and the influence of various stocks must not be overlooked.

The reader must not suppose that "iron-clad" varieties of fruit must lack, in any degree, appearance or quality. The market and home value of some of the most hardy apples, pears, and plums known is not surpassed by that of more tender sorts. Something is doubtless lost in range of season, when the number of varieties of any given fruit is narrowed by climatic limitations.

Rainfall.—Owing to severe drought, the spring of 1894 was the most unfavorable one for plant growth that has been known in the history of the Station. As will be shown elsewhere in this report, the orchard and vineyard were carried through without loss, owing to the excellent system of cultivation adopted; but the cereals were a complete failure here, as in the entire district. The small culture-plots received special attention and frequent hoeings, but even here the grain was not fit to cut for samples, and most of it failed to mature. In many cases, field-sown grain did not sprout at all, after sowing, so dry was the season. The total rainfall of the entire twelve months from July, 1893, to July, 1894, was 5.70 inches, distributed as follows:

1893—October	.21 inches.
November	.15 inches.
December	2.03 inches.
1894—January	1.06 inches.
February	.59 inches.
March	.21 inches.
April	.24 inches.
May	1.09 inches.
June	.12 inches.
Total	5.70 inches.

Drying winds in November, March, and April were of extraordinary duration and frequency; and the long intervals between showers must also be considered. Every effort was made by cultivation to utilize as much moisture as possible, but it may be fairly stated that the whole amount utilized by the cereals before they withered was less than four inches (3.68 inches between December 1st and March 1st). The subsequent showers were of no benefit to field crops, and of little value to the orchards. The May rains saved a great deal of hay, on the west side of the river.

Temperature Notes for 1894.—Accompanying this long drought was a succession of severe frosts. On November 12, 1893, a frost (27°) occurred which killed a good deal of vegetation. The leaves of figs, mulberries, and grapes were then frosted. On November 18th, the temperature fell to 19°, and on November 19th, to 20°. Olive, berries, and grapes were frozen. On December 29th and 30th, the thermometer fell to 27°; on January 6th and 7th, 1894, to 19°. The exposed water-pipes, on all these dates, were frozen. On February 16th, the temperature was 26°, and on March 3d, 25°, which destroyed all the almond blossoms then out. On March 21st, the temperature fell to 24°; on March 22d, to 25°; and on March 23d, to 26°, which used up all the remaining almond blooms, the apricot, and nearly all the peach, plum, and nectarine blossoms. On April 17th, another frost of 30°, finished all the plum and cherry blossoms, and destroyed more of the peaches and nectarines. These late frosts even cut back the new leaves of the figs, mulberries, and grapevines.

The highest temperature for June was 90°, but the minimum was 42°. For twenty-five days of July the thermometer registered over 90°, reaching 100° on the 22d and 102° on the 23d. For twenty days in August the thermometer showed 90° and over; the maximum, August 26th, was 105°. Thirteen days in September ranged to 90° and above, with 98° as the maximum.

The above points are further shown by the climatic tables accompanying this report, which include the time and severity of the frosts for two fiscal years (1893–94 and 1894–95), ending with June, 1895, and thus illustrates more plainly than words the climatic fluctuations of the district, which, though healthful, and to many persons extremely advantageous, is so ill adapted to some kinds of fruits:

PASO ROBLES TEMPERATURE REPORT FOR FISCAL YEARS 1893–94 AND 1894–95.

	Daily Mean.	Mean Daily Maximum.	Mean Daily Minimum.	Mean Daily Range.	Extreme Maximum, and Dates.		Extreme Minimum, and Dates.	
1893—July	72.77°	93.29°	52.25°	41.04°	106°	18th	46°	27th
August	71.89	92.41	51.38	41.03	104	1st, 2d	46	16th, 21st
Sept.	72.43	78.60	46.26	32.34	88	2d, 3d	38	23d
October	56.12	71.96	40.29	31.67	84	3d, 6th, 13th	32	18th, 19th
Nov.	49.66	63.63	35.70	27.93	74	14th	19	18th
December	47.80	59.09	36.51	22.58	72	3d	27	30th, 31st
1894—January	42.49	53.74	31.25	22.49	63	28th	19	6th, 7th
February	46.08	57.71	34.46	23.25	70	27th	25	16th
March	51.06	66.51	35.61	30.90	84	28th	24	21st
April	58.26	74.23	43.30	30.93	87	18th	30	17th
May	60.80	75.36	46.25	29.11	92	9th	38	15th, 16th
June	58.13	78.00	38.26	39.74	90	30th	42	11th
July	72.17	92.51	51.83	40.68	102	31st	43	17th
August	73.02	91.41	54.64	36.77	105	26th	40	15th
Sept.	68.63	85.06	51.60	33.46	98	21st	42	14th
October	59.09	72.61	45.58	27.03	88	4th, 5th	34	30th
Nov.	55.06	72.10	38.03	34.07	81	13th	30	23d
December	46.75	54.58	38.93	15.55	64	2d	24	2d
1895—January	45.04	53.95	36.16	17.79	64	11th	26	30th
February	49.85	61.46	38.25	23.21	70	19th, 22d, 28th	30	1st, 2d, 3d, 4th
March	50.48	61.22	39.74	21.48	76	25th	26	15th, 16th
April	55.16	68.16	42.16	26.00	82	21st	31	5th
May	61.23	77.70	44.77	32.93	94	12th	36	29th
June	66.28	85.33	47.23	38.10	102	23d	36	1st

Spring Frosts Since 1889.—The Station was established in October, 1889. The following table shows the spring frosts of 1890, 1891, 1892, and 1893, and needs only to be compared with the corresponding months of 1894 and 1895 to illustrate the chief climatic difficulty of the place:

SPRING FROSTS, 1890-95—MINIMUMS, AND DATES.

	February.	March.	April.
1890	26° 12th	32° 10th	32° 1st
	28° 20th	33° 11th	
	28° 23d	32° 12th	
	28° 26th, 27th	32° 14th	
1891	25° 9th	32° 7th	34° 1st, 8th, 9th
	26° 10th	30° 29th, 30th	
	30° 12th	32° 31st	
	31° 26th		
	32° 4th, 13th, 20th, 25th		
1892	30° 10th, 11th	30° 28th	32° 19th, 27th
	32° 5th	32° 26th	
1893	26° 2d	30° 12th	32° 7th, 8th, 13th
	28° 27th, 28th	32° 9th, 10th	
	30° 7th, 15th, 16th	33° 13th	
		34° 23d	
1894	25° 16th	24° 21st, 22d	30° 17th
1895	30° 1st, 2d, 3d, 4th	26° 15th, 16th	31° 5th

These two tables show plainly that, though the extreme cold of March, 1894, under its trying drought conditions, marked the most severe spring of six successive years, and, presumably, will not often be repeated, still the March and April frosts, had our orchard been of bearing age since 1890, would often have destroyed a large part of the fruit. The February frosts are not so important, because the blossoms are usually still protected; but the alternating warm days and high average maxima in February (maxima range from 57° to 64°) bring out the blossoms early in March, and anything below 34° is almost certain to destroy the crop of almonds and apricots, while anything below 32° will destroy all the cherries, excepting the hardier types, and most of the peaches. (The maxima of March range from 52° to 76°.) The climatic conditions of the locality, thus shown, deserve the closest attention.

Station Improvements.—Since the issuance of the last report, nearly $400 has been spent in permanent improvements. The well, which formerly went dry nearly every summer, has been sunk to an exhaustless water-bearing stratum; a new windmill has been put up, and the sheds, workshops, and corrals have been enlarged. The Station is situated where it can be of very great benefit to farmers and orchardists of an extensive district, embracing portions of at least five counties. It is pleasant to be able to report an increase of interest in Station work, and many more visitors from among the more intelligent farmers; also, a much more extended local distribution of scions and cuttings from orchard and vineyard. In the winter season farmers come from distances of twenty and forty miles to see the Station, to obtain advice about their orchards, and to carry home surplus vineyard trimmings of new varieties of grapes, with which to establish vineyards of their own. The demand from these sources is still almost entirely for table grapes. Such applicants come from all parts of the Coast Range valleys and hillsides, as far north as Pleyto and San Antonio, in Monterey County, and as far south as San Luis Obispo and Arroyo Grande. Forty or fifty such settlers from small mountain land-claims visit the Station every winter and spring, and receive a direct benefit, which they heartily appreciate. In every case they are only given scions or cuttings of varieties which they could not purchase, as the nurserymen do not grow them; and, by registering their names and addresses, the Station is able to call upon them for future reports.

The general appearance of the Station has considerably improved since the last report, owing partly to the greater age and size of the trees, partly to the better care taken of the garden, and partly to the new sheds and stable yards which occupy ground which was formerly waste. The new water-supply arrangement is elsewhere described. The Station needs collections of hardy ornamental succulents such as Agaves, Yuccas, Dracænas, Cacti, Dasylirions, and Mesembryanthemums to ornament a barren corner of the garden; but these can be obtained by degrees at slight expense.

THE ORCHARD.

The system of planting the orchard, and its development from year to year, have been described so completely in previous reports, that there is little to add. The late spring frosts of 1895 practically destroyed the crop of almonds and apricots, and seriously affected some other fruits, as will be shown more in detail under separate heads.

Drought Effects in the Orchard.—In further illustration of the season of 1894, I note that trees of the following varieties, in spite of all care that could be given, did not fully mature their leaves, but lost them before autumn:

Cherries—Yellow Spanish, Purity, and Lewelling.

Plums—Columbia, Peach, Botankio, Peter's Yellow Gage, Copper, and Shropshire Damson.

Apricots—Royal, Blenheim, St. Ambroise, and Beauge.

These three classes of fruits suffered most, and the pears least, in the entire orchard. But, as noted already, the bulk of the orchard shows surprising resistance. Some young trees planted in 1894, on the avenue, made growth in 1894 as follows: Pears (Bartlett and Winter Nelis), from three to three and a half feet; prunes, from four to four and a half feet; plums, from one to three feet.

New Varieties Planted.—Little planting was done in 1894, but some extremely important new fruits were included among those sent to the Station. The following were in good growing condition in 1895:

Apples—Gros Vor, 12 M, 15 M, Hoover, Buckingham, Australian, Aphis-proof, Glowing Coal, Ruby Gem, and Carlough.

Cherries—Qutorka, Amarelle Pruit, George's Glass, Yellow Glass, Abeso, and Slanka.

Peaches—Lyons' Cling and Crosby.

Nectarine—Balgowan.

Apricots—Shensi and Hind's.

Plums and Prunes—Wyat, Ungarish, and Simon (on Myrobalan).
Grapes—A number of new Persian and Italian varieties.

Nearly all the apples and all the cherries in the above list are intended for the new iron-clad orchard; and other varieties suitable for this purpose are already in nursery.

Almonds.—The almond orchard has shown extremely fine growth, considering the soil. But the experiment with almonds can now be considered fairly conclusive, in respect to fruitage. At this elevation, east of the Salinas, on similar soil and in localities subject to such late spring frosts, the almond should not be planted. To sum up the seasons, the trees in 1892 bore fairly, considering age, and in 1893 did much better, I X L, King's Softshell, Nonpareil, Sultana, and Papershell proving superior bearers, and producing nuts of good size and quality. The almond blossoming season of 1893 extended over a period of six weeks, and only two or three early varieties suffered from the spring frosts. This looked encouraging, and I X L was especially recommended for further trial, as blossoming well in mid-season and seemingly more hardy than some others. In 1894 the late frosts of March 3d (25° Fahr.) and March 21st (21° Fahr.) destroyed the entire almond crop. In the spring of 1895 similar frosts occurred on March 14th, 28°, March 15th, 26°, March 16th, 26°, and March 17th, 29°. March 30th the temperature fell to 30°, and April 5th to 31°. Hence, we have to report complete failure of crop for two years in succession, and two years out of four, which evidently compels extreme caution in the choice of localities fit for the commercial growth of the almond in this region.

The following table shows some comparative statistics of the past three seasons, in reference to five leading varieties, early and late, and plainly shows the difficulty:

Variety.	First Flower.	Full Flower.	First Leaf.	Full Leaf.	Flowering Season.	Crop Ripe.	Yield.	Frosted.
I X L—								
1893	Feb. 15	Mar. 1	Mar. 1	Mar. 15	20 days.	Aug. 30	10 lbs.	----------
1894	Feb. 16	Mar. 2	Mar. 6	Mar. 16	16 days.	----------	None.	Mar. 3
1895	Feb. 19	Mar. 3	Mar. 1	Mar. 20	18 days.	----------	None.	Mar. 14
Sultana—								
1893	Feb. 18	Feb. 26	Mar. 1	Mar. 14	22 days.	Aug. 21	8 lbs.	----------
1894	Feb. 16	Mar. 3	Mar. 6	Mar. 14	----------	----------	None.	Mar. 3
1895	Feb. 23	Mar. 4	Feb. 25	Mar. 13	22 days.	----------	None.	Mar. 14
Papershell—								
1893	Feb. 13	Feb. 27	Mar. 8	Mar. 20	23 days.	Aug. 21	7 lbs.	----------
1894	Feb. 19	Feb. 28	Mar. 5	Mar. 16	----------	----------	None.	Mar. 3
1895	Feb. 23	Mar. 4	Mar. 2	Mar. 20	20 days.	----------	None.	Mar. 14
King's Softshell—								
1893	Feb. 23	Mar. 10	Mar. 10	Mar. 26	23 days.	Aug. 21	7 lbs.	----------
1894	Feb. 26	Mar. 3	Mar. 12	Mar. 26	----------	----------	None.	Mar. 3
1895	Feb. 26	Mar. 2	Feb. 28	Mar. 20	----------	----------	None.	Mar. 14
Languedoc—								
1893	Mar. 10	Mar. 18	Mar. 18	Mar. 28	15 days.	Oct. 1	6 lbs.	----------
1894	Mar. 6	Mar. 20	Mar. 17	Mar. 30	----------	----------	None.	Mar. 21
1895	Mar. 8	Mar. 21	Mar. 18	Mar. 27	----------	----------	None.	Mar. 14

Since the destructive spring frosts in this locality are likely to occur any time between February 1st and April 1st, no variety is safe. When four severe spring frosts occur, as in March, 1895, almonds can hardly escape. The record further shows, that in 1894 the varieties in bearing at the Station were destroyed on the following dates:

March 3d—Harriott's Seedling, Ne Plus Ultra, Marie Dupreys, I X L, Sultana, Papershell. Total, 6 varieties.

March 21st—Bidwell's Mammoth (very hardy and hardshell variety), Drake's Seedling, Pistache, Texan Prolific, Languedoc, Nonpareil. Total, 6 varieties.

It is from the second of these lists that planters in such exposed localities should make their choice, as the frost of March 21, 1894 (21° Fahr.), was 4° colder than that of March 3d. There is this difference to be noted, however—the last four varieties which endured the frosts until March 21st did not open their blossoms until after the 3d, but Bidwell's Mammoth and Drake's Seedling had many flowers open before March 3d. It is likely that both would have borne fair crops had it not been for the later frost. Bidwell's Mammoth, while of the highest quality for home use, is not salable; Drake's Seedling is of the Languedoc type, and even a thinner shell is desirable, but no thinner-shelled variety known to the Station is more hardy. The soil on which these almond trees are planted is the granitic sandy loam of the southern portion of the tract, and is as well protected as any part of the orchard.

A number of almond seedlings have been grown at the Station from late-maturing nuts, so as to see whether any of them would escape the March frosts. They proved to vary but little more, in time of blossoming, than the grafted varieties; and none, out of eighteen seedlings, has shown any improvement in point of hardiness.

The following memoranda are from the foreman's notes on the almond orchard, in the summer of 1894:

Bidwell's Mammoth—Made a small growth; tree spreading and open, seemingly healthy.

Drake's Seedling—Made a low, spreading growth.

Harriott's Seedling—Grew well; tree compact, upright.

Ne Plus Ultra—Tree healthy and open in growth.

Pistache—A good, healthy growth; rather upright.

Sultana—Medium growth.

Papershell—Compact and upright growth.

I X L—Tree tall, spreading, healthy.

King's Softshell—The largest tree in the orchard, strong and tall.

Languedoc—Tree a close grower and tall.

Marie Dupreys—Top spreads; growth fair.

Golden State and Texan Prolific—Quite close in growth, upright, and of medium size for age.

Apples.—In 1894, the apples made a fair growth, considering the drought, excepting some trees in the poorer soil, from which oak trees have been removed, and where the "hardpan" is near the surface. Apple trees in this district should be started very low, as close to the ground and as spreading as practicable. The trunks should receive ample protection from sun during the first five or six years. This point is all-important.

The late spring frosts of 1894 destroyed some of the blossoms in the orchard of sixty-seven varieties. The apple crop was short in many parts of the district. In this respect the season was unusual, as apples are considered safe here. Only a few had arrived at a blossoming age. The trees coming into bearing stood the spring frosts of 1895 much better.

The following memoranda, by varieties, gives results for the season of 1894:

Alexander—Healthy growth of twelve inches.

Beauty of Kent—Average growth of twelve inches; tree healthy; spreading growth.

Benoni—Made a growth of twelve inches; upright.

Bailey's Sweeting—Made a growth of four feet; spreading.

Baldwin—Made a growth of three feet; spreading.

Colvert—Made a growth of four feet; healthy and upright.

Cooper's Early White—Made a growth of two and a half feet; healthy, low, and spreading.

Dickinson—Made a growth of two feet.

Duke of Devonshire—Made a growth of three feet.

English Golden Russet—Made a growth of two feet; tall and spreading.

Early Ripe—Made a growth of four feet.

Everbearing—Made a growth of two feet.

Fameuse—Made a growth of eighteen inches.

Gloria Mundi—No blossoms; made a growth of two feet; dying in part; growth upright.

Huntsman, Hass, Ingram, and Morton's Pearmain—Growth of three feet.

Jonathan—Made a growth of eighteen inches, on healthy side; the south side of tree is dying back badly.

Keswick Codlin—First flower, April 6th; first leaf, March 26th; blossoms were few; time of bloom period, nine days; set some fruit, but it was stolen by the birds. The tree made a growth of two feet, except on south side, which started poorly.

Lawver—Made a growth of sixteen inches; tree healthy, and making a very spreading growth.

Lady's Sweeting—Made growth of fourteen inches.

Missouri Pippin—First flower, April 4th; first leaf, March 29th; blossomed full, and was twelve days in bloom; set a few apples, and five came to maturity, and were picked November 10th; tree made a growth of two feet; healthy, with low and spreading growth.

Montreal Beauty—Made a growth of four feet.

Marshall's Seedling—Made a growth of sixteen inches.

Mann—Made a growth of fourteen inches.

Northern Spy—Made a growth of two feet; healthy, and very upright.

Ortley—Made a growth of eighteen inches.

Pewaukee—Made a growth of only seven inches, but healthy.

Porter—Made a growth of twenty inches.

Peck's Pleasant—Made a growth of two and a half feet.

Red Winter Pearmain—First flower, April 3d; first leaf, March 28th; blossomed full; length of bloom period, fourteen days; set some fruit, which was destroyed by woodpeckers; tree made a growth of only six inches, but was healthy.

Rhode Island Greening—First flower, April 2d; first leaf, March 20th; blossomed fairly well; length of bloom period, ten days; set a few fruits well, but they were destroyed by woodpeckers before ripening; tree made a growth of eight inches.

Red Beitigheimer—First flower, March 29th; first leaf, March 24th; a few blossoms; length of bloom period, ten days; fruit dropped off just after setting; tree made a growth of ten inches.

Rome Beauty—Made a growth of sixteen inches.

Red June—No blossoms; made a growth of two feet; healthy and upright.

Red Canada—First flower, April 8th; first leaf, April 6th; tree blossomed full; length of bloom period, twelve days, but cast its fruit after setting.

Red-Cheeked Pippin—Made a growth of three and a half feet.

Shannon—First flower, March 31st; first leaf, March 24th; bloomed twelve days, but cast its fruit; tree made a growth of twelve inches.

Skinner's Pippin—First flower, April 3d; first leaf, March 27th; blossoms few; length of bloom period, ten days; tree set no fruit, but made a growth of twelve inches.

Shackleford—Made a growth of four feet.

Sonoma—One half of tree is dying; rest of the tree made a growth of eighteen inches.

Siberian Crab—Made a growth of sixteen inches.

Twenty-Ounce—First flower, April 4th; first leaf, March 26th; blossomed fairly; length of bloom period, ten days; tree set no fruit; part of the tree is dying, the rest made a growth of twelve inches.

Transcendent Crab—Made a very few blossoms, but set no fruit; growth of tree was sixteen inches.

Walbridge—First flower, April 4th; first leaf, March 29th; blossoms, few; length of bloom period, ten days; tree set no fruit, but made a growth of eight inches.

White Winter Pearmain—First flower, March 28th; first leaf, March 19th; blossoms, full; length of bloom period, fifteen days; set some fruit, but it was destroyed by the woodpeckers; tree made a growth of eight inches.

Wagener—First flower, April 2d; first leaf, March 28th; blossoms, full; length of bloom period, sixteen days; grew a few apples, but they were eaten by birds before ripening; tree made a growth of twelve inches.

Wealthy, Winesap, Wolf River, and Whitney Crab—Made growths of three feet, and trees healthy.

Yellow Bellflower and Yellow Newtown Pippin—Made growths of about eighteen inches.

STATISTICS OF APPLE ORCHARD—1895.

Variety.	First Flower.	Full Flower.	First Leaf.	Full Leaf.	When Ripe.	Crop, in Pounds.
Alexander	Apr. 5	Apr. 15	Mar. 28	Apr. 22	Aug. 10	31
Beauty of Kent	Apr. 1	Apr. 10	Apr. 1	Apr. 20	Aug. 30	60
English Golden Russet.	Apr. 1	Apr. 19	Apr. 19	Apr. 22	Oct. 3	50
Fall Pippin	Apr. 2	Apr. 16	Apr. 8	Apr. 20	Aug. 31	60
Fameuse	Apr. 1	Apr. 15	Apr. 5	Apr. 26	Sept. 10	45
Gloria Mundi	Apr. 3	Apr. 15	Mar. 22	Apr. 15	Aug. 15	13
Jonathan	Apr. 8	Apr. 18	Mar. 26	Apr. 20	Aug. 10	3
Keswick Codlin	Apr. 3	Apr. 22	Apr. 1	Apr. 30	Aug. 1	10
Lawver	Apr. 4	Apr. 12	Apr. 4	Apr. 20	Sept. 20	18
Missouri Pippin	Apr. 10	Apr. 28	Apr. 1	Apr. 30	Oct. 3	30
Montreal Beauty	Apr. 6	Apr. 15	Mar. 26	Apr. 12	Aug. 3	20
Ortley	Apr. 6	Apr. 20	Mar. 30	Apr. 30	Sept. 25	10
Pewaukee	Apr. 22	May 1	Apr. 10	--------	Oct. 3	14
Red Beitigheimer	Apr. 3	Apr. 13	Mar. 22	Apr. 22	July 28	35
Rhode Island Greening	Apr. 4	Apr. 16	Mar. 26	Apr. 20	Oct. 3	50
Shannon	Apr. 8	Apr. 16	Mar. 20	Apr. 16	Oct. 25	10
Porter	Apr. 14	Apr. 22	Mar. 26	Apr. 28	Aug. 8	5

STATISTICS OF APPLE ORCHARD—Continued.

Variety.	First Flower.	Full Flower.	First Leaf.	Full Leaf.	When Ripe.	Crop, in Pounds.
Skinner's Seedling	Apr. 5	Apr. 16	Mar. 22	Apr. 20	Aug. 7	25
Stump	Mar. 28	Apr. 8	Mar. 16	Apr. 12	Aug. 8	30
Transcendent Crab	Mar. 26	Apr. 5	Mar. 8	Apr. 5	July 11	14
Vandevere	Apr. 3	Apr. 15	Mar. 20	Apr. 30	Oct. 30	20
Walbridge	Apr. 8	Apr. 20	Apr. 1	Apr. 22	Oct. 3	12
Wagener	Apr. 12	Apr. 28	Apr. 12	Apr. 28	Oct. 1	25
White Astrachan	Apr. 5	Apr. 15	Mar. 22	Apr. 12	Aug. 2	15
White Winter Pearmain	Apr. 1	Apr. 15	Mar. 16	Apr. 22	Oct. 4	16
Winesap	Apr. 12	Apr. 20	Apr. 10		Oct. 3	10
Yellow Newtown Pippin	Apr. 1	Apr. 15	Mar. 9	Apr. 20	Oct. 1	10

The apples were not large, but the quality was generally fair, and, in some cases, particularly good.

The following varieties blossomed well, but failed to set any fruit, probably because of the late frosts: Lincoln, Benoni, Yellow Bellflower, Flora Bell, Marshall's Seedling, Dickinson, Rambo, and Maiden's Blush.

The following blossomed sparsely, and bore a few apples: Shirley, Twenty-Ounce, Mann, Swaar, and Ben Davis.

The five best among the varieties comparatively new in the district are: Red Beitigheimer, White Astrachan, Beauty of Kent, Keswick Codlin, and English Golden Russet.

The Russet apples, which form a large and very valuable class, many of them late keepers, appear to be worthy of extended trial in this region. A collection of fifteen or more desirable varieties of Russets could easily be made. The old Roxbury Russet is the largest of the American sorts, and an excellent keeper. Among the best Scotch and English sorts not yet in cultivation in California are: Aromatic Russet, Rosemary Russet, Red-leaf Russet, Egremont Russet, and Royal Russet.

Apricots.—The apricots do poorly on the granitic sandy loam of the southern part of the orchard, but are an entire success nearer the slope of the now well-drained swale, where the soil is deeper and contains more humus and clay. (See Agricultural Experiment Station Report for 1890, pp. 96–102, for detailed soil-study of the Station tract.) Like the almond, the apricot is of very doubtful value in this district east of the Salinas, owing to late frosts. Good apricot orchards are in bearing west of the river, and we have reason to think that sheltered spots on the east side will be fit for this fruit. In 1893, the trees were too young for a bearing-test at the Station, but the seasons of 1894 and 1895 make the difficulty plain. The following notes are from the foreman's memoranda, made on the ground:

Newcastle (two trees)—In 1894, first flower, March 1st; first leaf, March 12th; blossomed full; fruit killed by frost, March 21st (24°); length of bloom period, fourteen days; trees grew well, producing three to four feet of new wood. In 1895, trees blossomed on February 27th; killed by frosts of March (see Almond report).

Peach (three trees)—In 1894, first flower, March 8th; first leaf, March 20th; they blossomed full, but were killed by frost; trees made growth of about three feet. In 1895, trees began to bloom March 6th; fruit lost by frost.

Smith's Triumph—In 1894, first flower, March 9th; first leaf, March 24th; blossomed fairly well, but were killed by frost; blossoms held on for sixteen days; this is the largest apricot tree at the Station, and made a growth of four or five feet. In 1895, the first flowers showed February 28th, but were killed by frost.

Orange—In 1894, first flower, March 1st; first leaf, March 24th; blossoms killed by frost; length of bloom period, fourteen days; the tree made a fair growth. In 1895, the tree bloomed March 5th, and leafed March 11th, but frost killed the blossoms.

Alberge de Montgamet—In 1894, first flower, March 8th; first leaf, March 24th; blossoms were killed by frost. In 1895, the first flowers appeared by March 4th; crop frosted; the tree made a growth of three feet.

Breda—In 1894, first flower, March 6th; first leaf, March 30th; the blossoms were killed by frost. In 1895, no flowers appeared.

Beauge—In 1894, first flower, March 4th; first leaf, March 19th; length of bloom period, twelve days; blossoms were killed by frost, March 21st. In 1895, the tree began to flower, March 4th, but the blossoms were frosted.

De Coulorge (two trees)—In 1894, first flower, March 8th; first leaf, March 26th; blossoms killed by frost; both trees made a very small growth. In 1895, the blossoms were again frosted.

Hemskirke—In 1894, first flower, March 16th; first leaf, March 26th; blossoms scanty, but killed by frost. In 1895, crop again destroyed.

Kaisha—In 1894, first flower, March 5th; first leaf, March 27th; killed by frost, March 21st. In 1895, bloomed, March 6th; crop lost, as usual.

Pringle—In 1894, first flower, March 4th; first leaf, March 14th; blossomed full, but killed by frost. In 1895, fair blossom crop, but again killed.

Purple, or Black—In 1894, first flower, March 15th; first leaf, March 26th; blossoms dropped a few days after the 21st of March; this variety is thought to be very hardy. In 1895, it showed flowers on March 9th, and bloomed for three weeks; set some fruit, which finally fell, weakened by late frosts.

Red Masculine—Did not bloom in 1894, nor in 1895.

Luizet (two trees)—In 1894, first flower, March 10th; first leaf, March 22d; fruit killed March 21st; trees healthy. In 1895, the trees bloomed, mainly, from March 4th to March 12th; crop was destroyed by the frost of March 14th; but some later blossoms came out and set a small crop.

Long Red—In 1894, first flower, March 8th; first leaf, March 28th; length of bloom period, ten days; blossoms were few, both in 1894 and 1895; crop lost both years.

Moorpark—Did not bloom either in 1894 or in 1895.

Blenheim—Slight bloom, and no fruit, in either 1894 or 1895.

Large Early Montgamet—In 1894, first flower, March 12th; first leaf, March 26th; length of bloom period, twelve days; but few blossoms, and those killed by frost. No flowers in 1895.

St. Ambroise—In 1894, first flower, March 12th; first leaf, March 27th; length of bloom period, ten days; blossoms few, and those were killed by frost. The crop was also lost in 1895.

Routier's Peach—In 1894, first flower, March 16th; first leaf, March 28th; blossoms frosted. In 1895, it flowered, March 9th; and crop was again lost.

Turkey—In 1894, first flower, March 10th; first leaf, March 27th; blossoms frosted. In 1895, it blossomed, March 4th, sparsely; again lost the crop.

From these notes, it is evident that only the hardiest North Asiatic and Russian types of apricot can succeed, and a collection of these is now being grown for the Station. Unless the scattering blossom-habit of varieties like Luizet can be developed, little can be expected from the better classes of apricots at this point.

Cherries.—The surprising need of "iron-clad" varieties of fruit is nearly as evident in the case of the cherry as of the almond and apricot, as the following notes sufficiently show. The cherry trees have suffered greatly from the hot summers. Especial care will always be necessary to keep trees in health here. The entire crop of 1894 was destroyed by the frost of April 17th (30°).

Schmidt's Bigarreau—In 1894, did not bloom at all; first leaf, March 31st. In 1895, flowered lightly, from March 22d to April 12th; but fruit was killed by frost.

Belle d'Orleans—In 1894, first flower, March 24th; first leaf, March 20th; crop killed by frost. In 1895, blossomed a little, March 7th to March 20th, and ripened a little fruit, of good quality and medium size.

Tradescant Black Heart—In 1894, first flower, March 14th; first leaf, March 20th; crop was killed by frost; tree made a large growth. In 1895, flowered mainly, April 1st to April 18th; was nearly all destroyed; late blossoms set and ripened.

Black Mastodon—In 1894, did not bloom. In 1895, it began to flower, March 28th; crop destroyed by frost.

Black Eagle—In 1894, first flower, March 26th; first leaf, March 26th; crop wholly frost-killed. In 1895, this tree bloomed from March 22d to April 14th; and a small number of fruits escaped the frost; quality excellent.

Werder's Early Black Heart—In 1894, first flower, March 25th; first leaf, March 24th; no crop. In 1895, in bloom from March 20th to April 12th; small crop set; quality fair, for the variety.

Willamette—In 1894, first flower, March 26th; first leaf, March 27th; no crop. In 1895, half dozen cherries set and ripened.

Centennial—In 1894, no blossoms. In 1895, bloomed lightly, from March 17th to April 4th; ripened a dozen cherries.

Windsor—In 1894, first flower and leaf, March 26th; no crop. In 1895, it was in bloom twenty-six days, from March 20th; set a fair crop, which it was impossible to protect fully from the birds; quality excellent, for the type.

Burr's Seedling—In 1894, first flower, March 28th; first leaf, March 26th; no crop. In 1895, it was in bloom from March 13th to April 14th; and set a light crop, two pounds in all.

Belle Magnifique—In 1894, no crop. In 1895, blossomed for eighteen days, beginning April 2d; and yielded seven pounds of fruit, of good quality.

California Advance—In 1894, no crop; tree made a short growth, and set but few blossoms. In 1895, it again bloomed lightly, and ripened a few cherries.

Major Francis—In 1894, first flower, March 29th; first leaf, March 26th; no crop. In 1895, crop again lost.

Reine Hortense—In 1894, first flower, March 29th; first leaf, March 26th; no crop. In 1895, ripened a few cherries, of large size for the variety.

Lincoln—In 1894, first flower, March 26th; first leaf, March 28th; no crop. In 1895, blossomed, from March 30th to April 16th; but the fruit did not mature.

Empress Eugenie—In 1894, no crop. In 1895, was in blossom for twenty-five days, from April 1st; and, the last flowers escaping the frost, the tree bore three pounds of fruit; the previous year, the tree was in bloom but sixteen days.

Pontiac—In 1894, first flower, March 26th; first leaf, March 26th; no crop. In 1895, the tree was in bloom twenty-four days, after March 22d; and set a light crop of four pounds, when mature; ripe, June 3d.

Black Tartarian—In 1894, did not bloom. In 1895, was in blossom twenty-eight days, from March 13th; and ripened a small crop of about three pounds.

Napoleon Bigarreau—In 1894, first flower, April 2d; first leaf, March 31st; no crop. In 1895, again lost the crop.

Coe's Transparent—In 1894, first flower, March 27th; first leaf, March 27th. In 1895, bloomed twenty-two days, from March 28th; a few late blossoms set fruit; ripening, June 1st.

Cleveland Bigarreau—In 1894, first flower, March 30th; first leaf, March 26th; no crop. In 1895, blossoming season began March 28th, and lasted twenty days; crop, two pounds; fruit ripened, May 24th.

Governor Wood—In 1894, first flower, March 28th; first leaf, March 28th; no crop. In 1895, it blossomed four days later than in 1894; fruit ripe, May 25th; crop, five pounds.

English Morello—In 1894, first flower, April 2d; first leaf, March 29th; total length of bloom period, fourteen days; no crop. In 1895, blossomed twenty days, from April 5th; and set full crop of twenty pounds; ripe, June 20th.

Great Bigarreau—In 1894, first flower, March 26th; first leaf, March 24th; period of scanty bloom, only eight days; no crop. In 1895, began to bloom, March 18th; made a bloom period of eighteen days; crop killed by frost.

Baumann's May—In 1894, no blossoms. In 1895, it had a bloom period of thirty-three days; crop did not mature.

Olivet—In 1894, no crop. In 1895, ripened half a dozen cherries.

Duchesse de Pallau—In 1894, first flower, April 2d; first leaf, March 29th; bloomed fourteen days; no crop. In 1895, bloomed twenty-six days; no crop.

Lewelling—In 1894, first flower, March 28th; first leaf, March 28th; length of bloom period, ten days; no crop. In 1895, blossomed twenty days; crop killed by frost.

Knight's Early Black—In 1894, first flower, March 26th; first leaf, March 26th; bloomed sixteen days; no crop. In 1895, bloomed twenty-five days; crop destroyed.

Purity—In 1894, first flower, March 28th; first leaf, March 26th; length of bloom period, thirteen days; no crop. In 1895, bloomed twenty-one days; small crop matured.

May Duke—In 1894, first flower, April 3d; first leaf, March 28th; length of bloom period, ten days; no crop. In 1895, bloomed twenty-three days; small crop ripened, May 25th; nearly three pounds; quality, best.

From this detailed report, we learn that the hardy Morello types are all that can be recommended here, although Black Eagle, May Duke, Belle Magnifique, and one or two others, give some promise under somewhat more favorable conditions, and on better soil. It would be folly to attempt to grow cherries for profit here; but there is reason to hope that we may obtain a selected list of hardy varieties, of great service for family orchards in similar localities. The Russian varieties at the Station are not yet old enough to bear. The remarkable variation from year to year, in blossom period, is worthy of notice. Doubtless, the dry spring of 1894 shortened this period, and so there were no late flowers to escape the frosts of that year.

Figs.—As previously reported, only a few figs, out of the long list that have been tested here, are hardy enough for the district; and none of these can be called a commercial success here.

In 1894, the frost of April 17th destroyed the leaves of all varieties of figs, in whole or in part. In many, the wood of the previous year's growth was cut down. Black California was killed to the surface of the ground. Black Bourjassotte and Pasteliere stood the trying season of 1894 better than any of the other varieties. The latter was the finer fruit, and one of the best grown here. December 1, 1894, an early frost (24°) killed all the leaves of the figs, and injured the tips of the branches. Few of the fig trees made more than six inches growth during 1894. Col di Signora Nero grew nearly three feet, but its fruits were not ripe when the December frosts came. No early crop of figs can be expected here, but the only useful varieties are those whose main crop is not later than September or October. Bulletin Smyrna did poorly; as, also, Ronde Noir. White Genoa and Osborne's Prolific, new varieties here, possibly hardier, were planted in 1894. A few notes on leading varieties, which bore some fruit, are given here:

Angelique is a fig that succeeds fairly. It begins to show leaves about April 8th. The second crop usually matures early in October, and is of fair quality.

Agen is another good fig here. The second crop is generally large, and ripens from October 1st to November 1st. Sometimes the early frosts injure it. The leaves appear from April 6th to April 10th.

Pasteliere, which does not show leaves till April 10th, ripens its first figs by August 8th, and bears, more or less continuously here, until October 15th. A very desirable variety.

White Ischia leafs out by April 15th, bears poorly; second crop ripens October 1st.

Dalmatian ripens late, and suffers badly from frost. Some figs ripen by October 18th.

White Adriatic shows the same tenderness here as elsewhere. The leaves appear March 12th, more than a month before some other varieties. The frosts of March destroy this crop, and another set of leaves appear about the end of April. The tree sets a few fruits late in autumn, which seldom ripen before the early frosts.

Black Bourjassotte, leafing April 12th, sets a full crop, which ripens from September 1st to late in October.

Black Brunswick, though not opening its leaves till April 20th, is not, in other respects, as hardy as the Bourjassotte.

Mulberries.—The mulberry is a much neglected tree, and should be far more extensively planted here. Some interest has now been aroused in the mulberries, and the Station annually distributes many cuttings to farmers east of the Salinas. Nine varieties are growing at the Station, and all withstood the drought of 1894, making a strong growth. The mulberries begin to show leaves from April 1st to April 7th. In 1894, these first leaves were cut by frost on April 17th, excepting in the case of the Persian, the Russian, and the Moretti varieties. These are, therefore, to be especially recommended. Nagasaki and Lhoo are usually touched by frost in November, or while still growing, and are likely to be killed back in some seasons.

Peaches.—The district appears to be excellent for many varieties of peaches, five years out of six; but the exceptionally dry and cold spring of 1894 caused a complete loss of the peach crop. Some trees lost their crop on March 21st, and some met with the same disaster on April 17th. A few scattering flowers, coming still later, failed to mature fruit. There was no curl leaf in 1894. Some leaves still hung to the trees in early December. The very light rainfall, and the poorness of the shallow soil, unite to make the general healthfulness and continued growth of the peach orchard, as shown in the following notes on varieties, especially significant of good culture. To sum up this point, nearly every tree in the orchard made a growth of from six to twelve inches, and one of eighteen inches, on thin soil with less than four inches of rainfall, scattered over long periods, with drying winds between. These were certainly hard conditions, and the behavior of the various varieties is, therefore, of especial interest.

Amsden's June—In 1894, first flower, March 10th; first leaf, March 24th; in bloom twenty days; no crop; the tree made an average growth of eighteen inches. In 1895, it was in bloom thirty days; crop large, nearly two hundred pounds; fruit began to ripen June 25th.

Alexander—In 1894, first flower, March 16th; first leaf, March 28th; bloomed eighteen days; part of the blossoms destroyed, March 21st; balance, April 17th. In 1895, it bloomed thirty-three days; yielded sixty pounds of fruit, which began to ripen June 24th; good crop both years.

Albright's Cling—In 1894, first flower, March 13th; first leaf, March 16th; blossomed full; flowers killed, March 21st; tree made a growth of six inches. In 1895, blooming period, from February 28th to April 3d; lost nearly all its crop by frosts; yield, five pounds; ripe, August 20th.

Beer's Smock—In 1894, first flower, March 17th; first leaf, March 24th; length of bloom period, nineteen days; fruit killed by frost, April 17th; tree made a growth of ten inches. In 1895, very small crop.

Bilyeu's Late—In 1894, first flower, March 17th; first leaf, March 28th; length of bloom period, eighteen days; fruit killed by frost, April 17th; average tree-growth of eight inches. In 1895, bloom period, thirty-two days; curled badly; set a small crop; seldom ripens well before the early frosts.

Brandywine—In 1894, first flower, March 13th; first leaf, March 19th; length of bloom period, sixteen days; most of the blossoms killed by frost, March 21st; tree made a growth of eight inches. In 1895, it began to bloom March 2d; was twenty-eight days in bloom; curled badly; lost some fruit by frost; ripened, September 9th; crop, ten pounds.

Briggs' May—In 1894, first flower, March 16th; first leaf, March 26th; length of bloom period, eighteen days; nearly all the blossoms killed, March 21st; tree made a growth of eighteen inches. In 1895, bloom period, twenty-eight days; crop, forty-seven pounds; fruit began to ripen June 22d; the first in the orchard.

Bonanza—In 1894, first flower, appeared March 12th; first leaf, March 17th; bloom period, sixteen days; blossoms killed March 21st; tree made a growth of twelve inches. In 1895, bloom period, thirty-five days; half the fruit lost by frost; the rest by curl leaf; not a bonanza in this district.

Belle Douai—In 1894, first flower, March 11th; first leaf, March 17th; length of bloom period, seventeen days; killed by frost, March 21st; tree grew thirteen inches. In 1895, the bloom period was thirty-five days, from March 2d; blossomed lightly; crop destroyed by squirrels from the adjacent grain fields.

Columbia—In 1894, first flower, March 16th; first leaf, March 24th; nearly all the blossoms were killed by frost, March 21st; length of bloom period, thirteen days; tree made a growth of seven inches. In 1895, bloom period was twenty-four days, from March 5th; crop was frost-killed; ground mulched.

Crawford's Late—In 1894, first flower, March 11th; first leaf, March 19th; length of bloom period, sixteen days; blossoms killed, March 21st; tree made a growth of twelve inches. In 1895, length of bloom period, thirty days; suffered greatly from frost; five peaches ripened, September 6th—the whole crop.

Crimson Beauty—In 1894, first flower, March 13th; first leaf, March 16th; length of bloom period, eighteen days; blossoms killed, March 21st; tree grew six inches. In 1895, length of bloom period, twenty-eight days; badly frosted; small crop, ripe October 25th.

California Cling—In 1894, first flower, March 12th; first leaf, March 16th; blossoms killed, March 21st; length of bloom period, fifteen days; tree made a growth of eight inches. In 1895, bloom period, twenty-five days; tree suffered from frost; crop light, ten pounds; ripe, from August 25th.

Chinese Cling—In 1894, first flower, March 13th; first leaf, March 15th; blossoms killed by frost, March 21st; length of bloom period, eighteen days; tree made a growth of eight inches. In 1895, length of bloom period, thirty days; some curl leaf; crop ripe, August 19th; twenty pounds.

Cooledge's Favorite—In 1894, first flower, March 11th; first leaf, March 22d; blossoms killed, March 21st; length of bloom period, twenty-four days; tree made a growth of three inches. In 1895, bloom period, thirty-five days; crop small, owing to curl leaf; stood frost very well; fruit ripe, August 1st.

Crawford's Early—In 1894, first flower, March 12th; first leaf, March 19th; blossoms killed, March 21st; length of bloom period, twenty days; tree made a growth of eight inches. In 1895, bloom period, thirty days, from March 3d; crop ripe, from August 14th to August 21st; forty pounds.

Early Rivers—In 1894, first flower, March 12th; first leaf, March 17th; blossoms nearly all killed, March 21st; length of bloom period, twenty-five days; tree-growth of eight inches. In 1895, bloom period, thirty-five days, from March 6th; small crop, matured July 10th; hardy, but subject to leaf curl.

Foster—In 1894, first flower, March 12th; first leaf, March 21st; length of bloom period, twenty days; flowers killed, March 21st; tree made an average growth of eight inches. In 1895, bloom period, thirty-four days, from March 4th; crop was ripe on August 8th, and after; yielded fifty-five pounds of fruit, of high color and quality; a standard variety of the Crawford type.

George's Late Cling—In 1894, first flower, March 13th; first leaf, March 20th; nearly all blossoms killed, March 21st; length of bloom period, twenty days; tree made an average growth of eight inches. In 1895, bloom period, thirty-two days, from March 4th; tree showed leaf curl, but bore fifty pounds of large peaches, which began to ripen, September 26th.

General Bidwell—In 1894, first flower, March 16th; first leaf, March 24th; length of bloom period, twenty days; blossoms killed, March 21st; tree made an average growth of ten inches; this was the last tree in the orchard to ripen its fruit. In 1895, the leaves curled badly; and this, together with frost, destroyed the crop.

Garey's Hold On—In 1894, first flower, March 12th; first leaf, March 24th; length of bloom period, twenty-two days; blossoms frosted, March 21st; tree made an average growth of twelve inches. In 1895, crop was again destroyed by frost.

Grover Cleveland—In 1894, first flower, March 12th; first leaf, March 19th; blossoms killed, March 21st; bloom period, twenty days; tree grew twelve inches. In 1895, flowering began March 5th, lasting thirty-five days; some curl leaf; fruit began to ripen, September 10th; total crop, fifty-seven pounds.

Hale's Early—In 1894, first flower, March 14th; first leaf, March 26th; length of bloom period, nineteen days; frost destroyed crop; average growth of tree, eight inches. In 1895, bloom period, thirty days; crop, ripe July 25th, was twelve pounds.

Henrietta—In 1894, bloom period, twenty-two days; no crop. In 1895, bloom period, thirty-two days; tree subject to curl leaf, and easily frosted; no crop.

Heath's Cling—In 1894, first flower, March 12th; first leaf, March 17th; blossoms killed, March 21st; tree made a growth of eight inches. In 1895, considerable curl leaf; tree bore twenty-two pounds of excellent fruit, which began to ripen, September 19th.

Honey Cling—In 1894, first flower, March 13th; first leaf, March 17th; blossoms frosted, March 21st; tree made a growth of eight inches. In 1895, bore thirty pounds of fruit, ripening from and after August 31st. Poor quality, here.

Honest Abe—In 1894, first flower, March 17th; first leaf, March 26th; blossoms killed, April 17th. In 1895, began to bloom, March 8th; bore ten pounds of large fruit, which began to ripen, September 2d.

Indian Blood Cling—In 1894, first flower, March 13th; first leaf, March 27th; crop lost, March 21st; length of bloom period, twelve days. In 1895, the bloom period of this variety was thirty-three days; the tree is subject to curl leaf, and somewhat tender; hence, a short crop of nine pounds; ripening from September 1st.

Italian Dwarf—In 1894, blossoms frosted. In 1895, crop also lost.

Jennie Worthen—In 1894, first flower, March 17th; first leaf, March 28th; length of bloom period, eighteen days; blossoms frost-killed, April 17th. In 1895, bloom period, thirty-five days; fruit ripened, June 25th; eleven pounds in weight; type of Briggs' May; tree of doubtful authenticity.

Large White Cling—In 1894, first flower, March 13th; first leaf, March 19th; blossoms were killed, March 21st. In 1895, crop was twelve pounds; fruit began to ripen, September 2d; bad attack of leaf curl.

Lemon Cling—In 1894, first flower, March 13th; first leaf, March 16th; blossoms frosted, March 21st; length of bloom period, twenty days; tree made an average growth of eight inches. In 1895, bloom period, thirty-five days; subject to late frosts; only a few fruits escaped; ripening, September 3d.

Late Admirable—In 1894, first flower, March 13th; first leaf, March 26th; blossoms killed, March 21st; length of bloom period, seventeen days. In 1895, bloom period, twenty-eight days; the crop ripened, September 9th; twenty-six pounds.

La Grange—In 1894, first flower, March 12th; first leaf, March 16th; blossoms were killed, March 21st. In 1895, curled badly; crop was again lost.

Lovell—In 1894, first flower, March 12th; first leaf, March 20th; blossoms were killed, March 21st; tree made a growth of eighteen inches, the best of any tree at the Station this dry summer. In 1895, the bloom period was thirty-five days, from February 27th; some curl leaf; crop, of thirty-seven pounds, ripening from August 30th.

McKevitt's Cling—In 1894, first flower, March 16th; first leaf, March 21st; length of bloom period, sixteen days; killed by frost, March 21st and April 17th. In 1895, bloom period, thirty-six days; frost killed again, so completely that only about a dozen peaches escaped; ripening, September 7th.

Mrs. Brett—In 1894, first flower, March 11th; first leaf, March 21st; blossoms were killed, March 21st; tree made a growth of twelve inches, and is now the largest peach tree at the Station. In 1895, the bloom period was thirty-five days, from March 3d; frost killed a large part of the blossoms; enough remained to produce one hundred and fifty pounds of choice fruit, which began to ripen August 28th. This is a new peach in this district.

Mountain Rose—In 1894, first flower, March 16th; first leaf, March 20th; length of bloom period, eighteen days; blossoms killed, April 17th. In 1895, bloom period, twenty-eight days; blossoms again frosted, only three or four peaches escaping.

Muir—In 1894, first flower, March 17th; first leaf, March 24th; length of bloom period, sixteen days; blossoms killed, April 17th; tree made a growth of twelve inches. In 1895, the bloom period was thirty-six days, from March 6th; crop began to ripen August 26th; the best tree bore fifty-four pounds of good fruit.

Morris White—In 1894, first flower, March 13th; first leaf, March 24th; blossoms frosted, March 21st. In 1895, crop again lost. The tree is especially tender, as it had a very long bloom period in 1895 (thirty-eight days), and a portion of the crop should have escaped.

Moore's Favorite—In 1894, first flower, March 10th; first leaf, March 16th; blossoms killed by frost, March 21st; tree grew twelve inches. In

1895, crop was small, and was eaten by squirrels from adjacent fields while still green; tree very susceptible to frost.

Newington Cling—In 1894, crop lost by frost. In 1895, again so lost.

Newhall—In 1894, crop lost. In 1895, crop lost.

Nichol's Orange Cling—In 1894, crop frosted March 21st; wholly destroyed. In 1895, crop frosted March 14th, 15th, and 16th; wholly destroyed. Not hardy enough.

Noblesse—In 1894, first flower, March 16th; first leaf, March 26th; blossoms frost-killed; length of bloom period, sixteen days. In 1895, bloom period was thirty-two days; a few flowers escaped frost, and ripened eight pounds of fruit, from and after August 5th.

Oldmixon Free—In 1894, first flower, March 13th; first leaf, March 24th; most of the blossoms killed, March 21st; whole season of bloom, twenty days; no crop. In 1895, the bloom period was thirty days, from March 6th; crop, of twenty-six pounds, began to ripen, August 17th.

Oldmixon Cling—In 1894, first flower, March 12th; first leaf, March 21st; part of the blossoms killed, March 21st; the rest, later; bloom period, eighteen days. In 1895, bloom period, thirty-five days; the frost of March 14th killed most of the crop; but nearly seven pounds ripened, August 20th and later.

Picquet's Late—In 1894, first flower, March 16th; first leaf, March 21st; blossoms were killed, March 21st and later; length of bloom period, eighteen days; tree made a growth of ten inches, despite drought. In 1895, bloom period was thirty days; tree lost half its crop; ripened thirty-five pounds of fruit, September 20th and thereafter.

Royal George—In 1894, first flower, March 12th; first leaf, March 20th; blossoms were killed, March 21st; tree made an average growth of twelve inches. In 1895, the crop was shortened by the frost of March 14th; but late flowers gave thirty-eight pounds of peaches, which began to ripen August 8th.

Runyon's Orange Cling—In 1894, first flower, March 15th; first leaf, March 24th; blossoms mostly killed, March 21st; others killed later; length of bloom period, eighteen days. In 1895, bloom period was thirty-four days; trees stood frost better than most varieties; crop of forty pounds, ripened on and after August 26th.

Susquehanna—In 1894, first flower, March 12th; first leaf, March 21st; blossoms all killed, March 21st. In 1895, large part of crop again lost by frost, March 14th; but twenty-eight pounds being gathered, on and after August 20th; quality unusually good.

Stump the World—In 1894, crop destroyed by frost. In 1895, again destroyed. In 1893, fruit poor. Not worth further trial here.

Smock's Late Free—In 1894, first flower, March 15th; first leaf, March 22d; blossoms nearly all killed, March 21st; length of bloom period, twenty days. In 1895, bloom period was thirty-two days; crop was thirty-five pounds, ripening on and after September 18th.

Salway—In 1894, first flower, March 13th; first leaf, March 16th; blossoms destroyed by frost, March 21st; tree made a growth of ten inches. In 1895, crop was thirty-eight pounds; beginning to ripen, October 1st.

Strawberry—In 1894, first flower, March 16th; first leaf, March 21st; part of the blossoms were killed, March 21st, and the rest, April 17th; tree grew twelve inches. In 1895, bloom period was thirty-one days; leaf curl was bad; tree suffered from frost; but twenty pounds of fruit set from late flowers, ripening September 10th.

Seller's Cling—In 1894, crop wholly lost. In 1895, only four pounds of fruit gathered; free from curl, but a tender variety here.

Tuscany Cling—In 1894, crop wholly lost. In 1895, only four pounds ripened, on August 15th and later. Not hardy here in average seasons; crop poor in 1893.

Thissell's White—In 1894, first flower, March 12th; first leaf, March 21st; blossoms all killed, March 21st. In 1895, bad attack of curl leaf; stood the frost well; ripened twenty pounds of fruit from and after September 12th.

Ulatis—In 1894, first flower, March 17th; first leaf, March 26th; blossoms killed, April 17th. In 1895, length of bloom period was thirty-three days; crop began to ripen, June 26th; yielded one hundred and forty-seven pounds.

Wilkins' Cling—In 1894, crop lost from frost. In 1895, again from frost, and leaf curl. Not worth further test here.

Ward's Late Free—In 1894, crop destroyed by frost, in March. In 1895, again, by curl leaf and frost. Not a success here.

Wheatland—In 1894, crop lost from frost. In 1895, again nearly so from same cause; six peaches ripened, first week in September.

Waterloo—In 1894, first flower, March 17th; first leaf, March 26th; blossoms few, and killed March 17th; tree made a growth of twelve inches. In 1895, bloom season, thirty-eight days; large crop, over one hundred pounds, ripe on June 29th. A promising variety here, in ordinary seasons.

Wager—In 1894, first flower, March 16th; first leaf, March 20th; blossoms killed, March 21st. In 1895, the crop was twenty pounds; no leaf curl; fruit of poor quality here.

Wonderful—In 1894, first flower, March 13th; first leaf, March 26th; blossoms nearly all killed March 21st; length of bloom period, fourteen days. In 1895, bloom period, thirty-five days; crop was sixty-five pounds, ripening from and after September 23d. Trees made strong growth both years.

Yellow St. John—In 1894, crop wholly lost. In 1895, crop was only three pounds; free from curl, but is very subject to frost.

Yellow Chance (a seedling)—In 1894, first flower, March 12th; first leaf, March 22d; blossoms all killed, March 21st; tree grew twelve inches. In 1895, crop was fifty-two pounds; ripening on and after September 20th.

Nectarines.—Early Newington—In 1894, no crop, because of frosts; this tree's bloom period was twenty-one days. In 1895, crop was thirty pounds; ripe on and after August 15th; bloom period was forty days; a little curl leaf. In 1893, first year of bearing, there was a good crop. This variety is valuable here.

Lord Napier—In 1894, no crop. In 1895, stood the frosts very well; a little curl leaf; fruit, eight pounds, ripe from August 13th; bloom period, five days shorter than Early Newington's.

Stanwick—In 1893, fair crop. In 1894, crop killed by frost of March 17th; bloom period, eighteen days. In 1895, bloom period, thirty-five days; suffered from frost, and set only ten pounds of fruit, which began to ripen August 12th.

Downton—In 1894, crop killed by frost; bloom period, twenty-two days. In 1895, crop was forty-five pounds; ripe on and after August 14th; bloom period, thirty-eight days. An early variety here.

Boston—In 1893 and 1894, no crop; no curl leaf. Tender variety, as crop was also practically lost in 1895, by March frosts. This variety is, so far, a failure here. The same remark applies to Duc de Vitry and to New White. A few scattering late blossoms escaped.

Hardwicke's Seedling—Is a somewhat better bearer than the above. It is free from leaf curl, and, in 1895, the crop was about eighteen pounds, ripening on and after August 12th. The frost of March 14th destroyed four fifths of the crop.

Victoria—This is the best variety so far tested here; a small crop was obtained in 1893 (tree then five years old). In 1894, the frost destroyed all the blossoms. In 1895, the long bloom season (forty days, from March 6th) enabled the later blossoms to escape the frosts of March 14th, 15th, and 17th, so that over sixty pounds of fruit set, and ripened on and after August 30th. The tree-growth was excellent. In ordinary seasons, this nectarine will bear well in this region.

Conclusions from Peach and Nectarine Notes.—The preceding notes embrace seventy-two varieties of peaches and nectarines. Five varieties of seedlings originating on the Station, and a number of trees not yet of sufficient age to bear, are not listed here. So extended a test is fairly conclusive of the following points: (1) The late frosts shorten the crop nearly every year; (2) In cold, dry springs, such as that of 1894, the peaches bloom from eight to twelve days later than in moister and warmer seasons, such as 1895 and 1893; (3) The sole dependence for peach and nectarine crops, even in ordinary seasons, in this locality, must be upon the late blossoms, hence a long period of bloom is essential; (4) In such seasons as 1895, the bloom period of most varieties is nearly double the bloom period of the same varieties in such seasons as that of 1894, as was also noticeable in length as compared with that of the same varieties in other parts of the State. This tendency is encouraging, since there does not seem to be any really iron-clad variety yet at the Station.

Among the peaches, several appear to promise better than others—that is, they have yielded fair crops two seasons out of three—and if we are justified in considering the spring of 1894 as phenomenal, these varieties may be recommended for this locality. But if similar springs are likely to occur, at intervals of four or five years, still more hardy peaches and nectarines must be found. The more useful varieties of peaches are the following: Early varieties—Amsden's June, Alexander, Waterloo. Main crop—Foster, Mrs. Brett, Muir, Wonderful, Yellow Chance, George's Late Cling, and possibly Runyon's Orange Cling. The best nectarine so far is Victoria, with Early Newington and Downton especially worthy of a further trial.

Pears.—The pear orchard is just coming into bearing, and will be of much value. It is partly in the swale, partly north, on heavier soil, and shows excellent growth. In 1894 and 1895 a large number of varieties bloomed slightly, and a few fairly well, but set very little fruit, as the trees were young and the late frosts unusually severe. Still the pear, at the present time, is one of the most promising fruits in this locality.

As noted in previous report, a portion of the fig avenue in the swale, and north, was killed by frosts. It was replaced, in the winter of 1893, by pears and prunes; new varieties in part, and in part large stocks for future grafting.

The hardiest of the pears at the Station are the Japanese seedlings, two of which bore fruit for the first time in 1894; an excellent cooking pear, if the hard core be removed. Trees grow with immense vigor, and are likely to prove great bearers. This is certainly the best stock for the region, as all the pears on Japan stock show remarkable vigor. The leaves are large, firm, and entirely free from disease. The best of the Station seedlings will be propagated for distribution, if further tests confirm these views. It is thornless, beautiful in appearance, and, as noted, bears a good kitchen fruit. It will not be necessary, however, to depend upon the Oriental pears for table use in this district.

In 1894, the Seckel was the only pear of European type which bore fruit. In 1895, the following varieties bore from five to fifty pears apiece: Beurré d'Anjou, Mt. Vernon, Louise Bonne de Jersey, Frederick Clapp, Doyenne d'Eté, Van Mons' Leon le Clerc, Gray Doyenne, and Beurré Gris d'Hiver Nouveau. There are more than sixty varieties of pears at the Station, besides the seedlings, and thirty or forty of these should bear a little fruit in 1896. An addition to the pear orchard seems justified by the conditions of the trees already planted; particularly in the line of late keepers, for commercial purposes.

During the severe season of 1894, the pear trees made a growth of from two to five feet, surpassing, in this respect, all other species of fruit trees. The following table upon blossoming periods illustrates the advantage which the pear has, in this locality, over other fruits:

STATISTICS OF PEAR ORCHARD.

Variety.	1894.		1895.	
	First Flower.	Bloom Period.	First Flower.	Bloom Period.
Beurré d'Anjou	March 28	11 days	March 30	16 days.
Beurré Diel	No blossoms		April 1	20 days.
Beurré Giffard	No blossoms		April 2	14 days.
Beurré Gris d'Hiver Nouveau	No blossoms		April 1	15 days.
Belle Lucrative	No blossoms		April 2	12 days.
Colonel Wilder	No blossoms		April 3	17 days.
Columbia	No blossoms		March 30	11 days.
Dix	March 31	9 days	March 29	10 days.
Doyenne d'Alençon	No blossoms		March 26	12 days.
Doyenne d'Eté	No blossoms		March 25	21 days.
Forelle	No blossoms		March 9	22 days.
Frederick Clapp	No blossoms		March 31	14 days.
Glout Morçeau	March 28	12 days	April 1	18 days.
Gray Doyenne	March 28		April 2	14 days.
Howell	March 28		March 23	22 days.
Idaho	March 28		March 28	17 days.
Josephine de Malines	March 24	12 days	March 30	10 days.
Keiffer	No blossoms		March 14	20 days.
Kennedy	March 30	14 days	March 28	10 days.
Lawrence	March 24	11 days	March 26	18 days.
Louise Bonne de Jersey	No blossoms		March 28	10 days.
Mount Vernon	No blossoms		March 25	18 days.
Nouveau Poiteau	No blossoms		April 8	12 days.
Onondaga (Swan's Orange)	March 30	10 days	April 1	18 days.
P. Barry	No blossoms		March 23	17 days.
Souvenir d'Esperen	March 26	14 days	March 28	11 days.
Seckel	March 31	12 days	No blossoms	
Van Mons' Leon le Clerc	No blossoms		March 23	26 days.
White Doyenne	April 1	10 days	March 30	16 days.
Winter Nelis	No blossoms		March 31	19 days.

There is a wide range shown here between the March 9th of Forelle and the April 8th of Nouveau Poiteau, as dates of first blossoms, or between the nine-day period of Dix, in 1894, and the twenty-six-day period of Van Mons' Leon le Clerc, in 1895. The late-blooming pears need not be considered as intrinsically hardier, but their chances of escaping the spring frosts are thereby increased. If the long blossom period of nearly a month, in some cases, could be united to the latest date of first flower, it would be an advantage in this locality, where in some seasons even the pear crop will be cut short. Still, with care, a selection of varieties which are reasonably safe may be made for even the frostier parts of this district.

Plums and Prunes.—The preceding notes upon climatic conditions, and the almond, apricot, cherry, and peach orchards, apply with more or less force to much of the plum and prune orchard also. The large surrounding grain fields are full of squirrels, which have heretofore come into the orchard and carried off a good deal of ripening fruit—apricots, peaches, and plums—in spite of poison and gun. Some of the soil devoted to plums is very poor, and must be fertilized, to carry a fruit crop any longer. It must be remembered that the plums and prunes are only just beginning to reach a bearing age, and that the following notes are based, in many cases, upon few and scattered blossoms. A proper test of this class of fruits will require two more seasons.

Autumn Gage—In 1894, the first flower was March 26th; first leaf, March 28th; length of bloom period, twelve days; crop killed by frost. In 1895, there was a bloom period of sixteen days, from March 21st; crop again lost.

Bradshaw—In 1894, first flower, April 2d; first leaf, April 6th; length of bloom period, eight days; blossoms few; tree made a growth of two feet; no crop. In 1895, blossomed April 9th; owing to being frosted, only four pounds of fruit ripened August 10th.

Bavay's Green Gage—In 1894, first flower, March 27th; first leaf, March 30th; bloom period, eight days; two and a half feet of tree-growth; tree spreading, In 1895, first bloom, April 2d; large crop of fruit (fifty pounds), ripening August 27th.

Botankio—In 1894, first flower, March 12th; first leaf, March 17th; length of bloom period, ten days; blossoms killed by frost of March 21st; no crop. In 1895, frosted March 14th; no crop. Tree bore a small crop in 1893. Blooms too early for this district.

Botan—In 1894, first flower, March 12th; first leaf, March 20th; length of bloom period, ten days.; fruit killed by frost of March 21st. In 1895, no crop; again killed by frost.

Burbank—In 1894, first flower, March 16th; first leaf, March 25th; blossoms killed March 21st. In 1895, blossomed from March 9th to April 8th; set a fair crop, which was carried off by the squirrels. Stood the frost better than any other Oriental plum at the Station. Worth extended trial.

Blue Damson—In 1894, first flower, March 26th; first leaf, April 4th; no fruit. In 1895, bloom period, sixteen days, from March 25th; crop of thirty-five pounds, ripening August 25th; usually extremely hardy.

Bryanston's Gage—In 1894, first flower, March 27th; first leaf, March 29th; length of bloom period, eight days; fruit lost by frost of April 17th. In 1895, no crop.

Blood Plum of Satsuma—In 1894, first flower, March 8th; first leaf, March 13th; length of bloom period, fourteen days; blossoms killed by frost. In 1895, crop again lost by frost of March 14th. Tree a failure on plum stock here.

Czar—In 1894, first flower, March 28th; first leaf, April 2d; length of bloom period, eight days; but few blossoms; made a growth of five inches, though in very poor soil; crop destroyed by frost in April. In 1895, crop nearly all killed; three pounds of fruit, ripening August 10th.

Coe's Golden Drop—In 1894, first flower, March 27th; first leaf, April 2d; bloom period, ten days in 1894, and twenty-three days in 1895; ripened forty pounds to the tree, beginning April 25th. One of the best plums at the Station.

Cherry Plum—In 1894, first flower, March 8th; first leaf, March 18th; bloom period, fourteen days; blossoms killed by frost, March 21st. In 1895, crop again lost, March 14th. This variety blossoms much too early for this locality; it is sometimes in bloom by February 28th.

Columbia—In 1894, first flower, April 5th; first leaf, April 5th; length of bloom period, eight days; blossoms few, and frosted April 17th. In 1895, crop nearly all lost again; four pounds of fruit ripened August 11th.

Chabot Blood—In 1894, first flower, March 8th; first leaf, March 14th; length of bloom period, fourteen days; blossoms few, and killed March 21st. The same loss was repeated in 1895. This variety is not a success here, unless it does better on peach stock.

Damas Noir—In 1894, first flower, March 26th; first leaf, April 2d; length of bloom period, nine days; tree made a good growth of two and one half feet; no fruit by reason of frost of April 17th. In 1895, blossomed March 28th; fruit ripened, July 22d; tree bore eighteen pounds.

Damson—In 1894, first flower, April 2d; first leaf, April 4th; length of bloom period, twelve days; made a growth of two feet; healthy, with spreading head; fruited fairly in 1894. In 1895, fruited again, ripening July 22d. Tree on poor soil; worth replanting in better location.

Dennison's Superb—In 1894, first flower, March 26th; first leaf, March 28th; length of bloom period, nine days; blossoms but few; tree made a growth of two and a half feet; crop frosted April 17th. In 1895, no crop, though bloom period was doubled.

Early Golden Drop—In 1894, first flower, March 27th; first leaf, April 7th; length of bloom period, nine days; made a growth of two and a half feet; crop lost. In 1895, a few flowers set; crop, two pounds; ripened July 1st.

Early Prolific—In 1894, no blossoms. In 1895, bloom period, sixteen days from March 27th; blossomed full, but affected by frost; ripened four and a half pounds of fruit from and after July 8th.

General Hand—In 1894, first flower, March 28th; first leaf, March 28th; length of bloom period, nine days; tree made a good growth. No crop in 1894 nor in 1895.

Imperial Gage—In 1894, first flower, March 26th; first leaf, April 3d; length of bloom period, ten days; crop lost, April 17th. In 1895, bloom period, eighteen days; bore thirty-eight pounds of fruit; began to ripen August 13th.

Ives' Autumn—In 1894, first flower, March 26th; first leaf, April 3d; length of bloom period, twelve days; blossoms, fair; tree made a fair growth, but no crop. In 1895, bloom period, twenty-two days from March 26th; few blossoms; five pounds of fruit, ripening August 8th.

Ickworth's Imperatrice—In 1894, no blossoms. In 1895, began to bloom lightly on April 5th, desirably late; ripened a small crop August 14th—perhaps six pounds—which was partly carried off by squirrels.

Jefferson—In 1894, first flower, March 24th; first leaf, March 30th; length of bloom period, eleven days; blossoms, very few, and no crop. In 1895, bloom period, twenty days; small crop, which was destroyed by squirrels.

Kelsey—In 1894, first bloom, March 12th; first leaf, March 15th; length of bloom period, ten days; blossoms, but few; three trees all made a growth of two to three feet; crop frosted. In 1895, crop frosted.

McLaughlin—In 1894, first flower, March 28th; first leaf, March 28th; length of bloom period, twelve days; blossoms few, but no fruit set. Tree on poor soil. No crop in 1895.

Morocco—In 1894, first flower, March 26th; first leaf, March 28th; length of bloom period, ten days; blossomed poorly; grew two feet. No crop in 1894 nor in 1895.

Monroe Gage—In 1894, first flower, March 25th; first leaf, April 3d; length of bloom period, nine days; crop lost. In 1895, bloom period, sixteen days; small crop, eaten by squirrels.

Oullin's Golden—In 1894, first flower, March 27th; first leaf, April 2d; length of bloom period, eight days; frosted, April 17th. In 1895, bloom period, eighteen days; crop of forty-five pounds, ripening on and after August 28th.

Ogon—In 1894, first flower, March 8th; first leaf, March 14th; length of bloom period, thirteen days; killed by frost of March 21st. Crop again destroyed in 1895.

Perdrigon Blanc—In 1894, no blossoms. In 1895, ripened two pounds of fruit, beginning September 25th; first bloom was April 5th. Variety promises well here.

Peach Plum—In 1894, first flower, April 2d; first leaf, April 5th; length of bloom period, eight days; blossoms few, and crop lost April 17th. In 1895, blossomed April 8th; bloom period, eighteen days; fruit began to ripen July 12th; crop, twelve and a half pounds.

Pond's Seedling—In 1894, first flower, March 27th; first leaf, April 3d; length of bloom period, ten days. In 1895, blossomed a little; bloom period, twenty-three days; yielded five pounds of fruit, which commenced to ripen August 12th.

Quackenboss—In 1894, first flower, March 26th; first leaf, April 3d; length of bloom period, nine days; no crop. In 1895, four plums, ripening August 26th.

Précoce de Bergthold—In 1894, first flower, March 24th; first leaf, April 3d; fruit destroyed, April 17th. In 1895, bloom period, fifteen days, as against twelve days in 1894; fruit began to ripen July 9th, and thirteen pounds was gathered.

Red Egg—In 1894, first flower, March 26th; first leaf, April 2d; length of bloom period, ten days; crop lost. In 1895, bloom period, sixteen days; crop killed by frost.

Reine Claude de Bavay—In 1894, first flower, March 28th; first leaf, April 2d; blossoms killed by frost. No crop in 1895.

Royal Hâtive—In 1894, first flower, March 20th; first leaf, March 29th; blossoms frost-killed. In 1895, three and a half pounds of fruit, which ripened July 10th.

Smith's Orleans (on peach)—In 1894, no crop. In 1895, bloom period of eighteen days, from April 6th; and bore eleven plums, ripening August 10th.

Same variety (on plum)—In 1894, no crop. In 1895, bloom period, twenty-five days from March 30th; bore twenty pounds, ripening August 15th. The plum stock would seem to have some advantage.

Shropshire Damson—In 1894, very few blossoms; no crop. In 1895, blossomed twenty days, from April 1st; and ripened nineteen pounds of fruit, beginning August 28th.

Simon—In 1894, first flower, March 8th; first leaf, March 15th; blossoms killed by frost, March 21st. In 1895, blossoms again killed.

St. Lawrence—In 1894, first flower, March 27th; first leaf, April 1st; length of bloom period, nine days; blossoms killed by frost. In 1895, bloom period, eighteen days; tree did well, and bore fifteen pounds of fruit, beginning to ripen August 8th.

Victoria—In 1894, first flower, March 28th; first leaf, April 4th; blossoms killed by frost. No crop in 1895. Not worth planting here.

Washington—In 1894, first flower, March 30th; first leaf, April 5th; length of bloom period, twelve days; blossoms frosted. In 1895, bloom period, eighteen days; crop of ten pounds, ripening July 28th.

Yellow Gage—In 1894, first flower, March 27th; first leaf, March 29th; few blossoms, and those frosted. In 1895, small crop set; quality, poor.

Barry Prune—In 1894, first flower, March 27th; first leaf, March 31st; length of bloom period, eleven days; crop lost. In 1895, bloom period, sixteen days; a fair crop, chiefly eaten by squirrels.

German Prune—In 1894, first flower, April 2d; first leaf, April 6th; blossoms frosted; no crop. In 1895, no crop.

Golden Prune—In 1894, first flower, March 31st; first leaf, April 3d; crop lost. In 1895, a small crop.

Petite Prune d'Agen—In 1894, first flower, March 26th; first leaf, March 29th; crop destroyed. In 1895, large crop set, which began to ripen, but was stolen.

Prince Englebert—In 1894, first flower, April 2d; first leaf, April 2d; length of bloom period, seven days; no crop. In 1895, bloom period, twenty days; crop of thirty pounds, which ripened September 1st.

Robe de Sergent—In 1894, first flower, March 27th; first leaf, April 5th; length of bloom period, eight days; crop lost. In 1895, bloom period, eighteen days; crop of fifty pounds, began to ripen August 31st.

St. Martins—In 1894, first flower, April 2d; first leaf, April 4th; no crop. In 1895, very small crop.

From this report, it is evident that few plums and prunes are even approximately safe in this locality. If we reckon the season of 1894 as not likely to be often repeated, we shall still have need of great care to make a reasonable list suitable for the district. The best prunes are evidently Robe de Sergent and Prince Englebert; also, probably Petite Prune d'Agen, which does well nearer the river, and west. The Silver Prune can also be highly recommended. Barry and Golden may be worth further trial.

The only plums of European type that can be recommended for general planting are Bavay's Green Gage, the Damsons, Coe's Golden Drop, Oullin's Golden, and Imperial Gage. Peach, Ickworth's Imperatrice, and a few others may be worth further trial. The Oriental plums, with the exception of Burbank, have done badly, and as yet we have not sufficiently tested the American varieties.

Olives.—The behavior of the olive orchard, during the trying season of 1894, showed plainly that but few varieties will ever be profitable on this tract. The general outlook for this fruit is not as satisfactory as it appeared in 1893. Oblonga, Polymorpha, Præcox, Picholine, and Rufa bore some fruit in 1894. All varieties made very slow growth, and have gained little in size since 1893, because the severe late frosts of 1894 and 1895 have so cut back the new wood. Otherwise, the trees are healthy, but all the fruit has been destroyed both years. The future of olives here is, therefore, still problematical.

The following memoranda give the time when new growth starts in this district:

In 1894, Atroviolacea, April 5th; Atrorubens, April 16th; Columbella, April 9th; Correggiolo, April 5th; Mission, April 19th; Macrocarpa, April 17th; Nevadillo Blanco, April 10th; Oblonga, April 4th; Polymorpha, April 10th; Picholine, April 6th; Regalis, April 16th; Razzo, April 17th; Salonica, April 4th.

The following dates of bloom were noted in 1895: Rufa, May 3d; Salonica, May 1st; Oblonga, May 5th; Picholine, May 8th; Polymorpha, May 10th; Præcox, May 10th; other varieties, no blossoms.

Other Fruits and Nuts.—The *Quinces* did so poorly on the granitic sandy loam, that the only hope for this species is on the heavier soils, or in the swale. The quince thrives fairly west of the river.

English Walnuts are an entire failure. The air is too dry; the leaves burn, and the tree ceases to grow, except feebly, from year to year. Even in the midst of a grass plot, where it receives water, an English walnut is barely alive. The *Pecans* are also at a standstill. *Italian Chestnuts* are a little better.

Small Fruits.—Nothing has been done with *Strawberries;* replanted at the beginning of every winter, a fair crop would be obtained. Fine berries are raised by irrigation on bottom land, both east and west of the Station, on tributary streams of the Salinas. The best of all the small fruits, under our trying conditions, is the *Logan berry.* In the dry season of 1894, this berry bore well, ripening almost continuously from June 8th to August 20th. The vines were in poor and shallow soil, without irrigation, or shelter from the sun. In 1895, the season was a fortnight longer, and the crop was larger. The plants grew well, and nearly a hundred were rooted from tips, and distributed in the district, as this fine hybrid berry seems to be the best small fruit yet tested here.

CEREALS.

The following notes upon the cereal crop during 1894 should be compared with those upon the orchard, in order to enable the reader to appreciate the hard conditions of the season:

Failure of 1894.—A large collection of new varieties of cereals was sown for testing and for samples for the office. The first sowing was January 10th, and the second sowing was February 1st. Nearly one hundred and fifty varieties were thus planted. As it happened, the late-sown cereals held out best; but this does not disprove former experience here, which favors the rule of very early sowing. In this case, so long a time elapsed without rain, that before it came, the early-sown lots were quite beyond recovery; but the late-sown were still green, and so recovered to some extent. Splendid grain, of all varieties, has been grown at the Station in previous years, obtaining the highest awards at district fairs, and honorable mention at the Midwinter Fair.

Wheat, as a rule, stood the drought rather better than other cereals. By April 15th, all the culture plots, however, began to turn yellow. By May 15th, nearly everything was dead, without having made grain.

Barley, sown broadcast, January 3d, on the best adobe soil on the tract, began to turn yellow on March 1st, and was then cut, to save what was left, for hay.

Barley, sown broadcast on plots of one tenth of an acre, eight pounds of seed per plot, on January 10th, began to turn yellow on April 12th. Ten plots of this size, fertilized in various ways, showed the longer endurance, as above noted, of the time between March 1st and April 12th. A large top-dressing of nitrate did no good, as there was not sufficient moisture to utilize it. By the first of May, the grain on all these plots was dead.

Crop of 1895.—Though conditions were not altogether favorable in 1895, the cereal plots gave fair results, and a large collection of specimens was taken for exhibition. Few new varieties were sown. Early rains enabled the foreman to prepare the soil, so as to sow most of the plots on November 12th and 13th, 1894. The varieties headed out at various dates from April 20th to May 28th, 1895, and were cut between July 20th and 25th. This collection has been so fully described and tabulated, in previous reports, that further detail seems hardly necessary.

Hay Crops.—In 1894, very little hay was raised east of the Salinas. In 1895, the Station rented a field of about twenty acres, south of the county road, and opposite the Station tract, at a very reasonable cost, to grow hay. Here we planted Australian White wheat, Club wheat, Berkeley Hybrid barley, Nepaul barley, and German millet, which has been highly recommended for the uplands of Texas. The latter came up badly, and made a sparse growth. Australian wheat and Nepaul barley gave the best crop. We cut twenty-four tons of hay from eighteen acres of land, having what farmers called the best looking hay in the region. Counting all expenses, we obtained our hay at a trifle less than $5 a ton. Heretofore we have bought our supply, at from $8 to $10, and in the year of drought at $15 per ton.

THE VEGETABLE GARDEN.

A small vegetable garden has been kept up by the foreman. Very few farmers on the uplands in this region make any attempt to grow vegetables at all, and those that do are soon discouraged, in most cases. The few vegetable gardens in and about Paso Robles are on bottom lands, and irrigated. It is generally said that no vegetables can be grown without irrigation on this upland, but, with proper care much may be done.

In the spring of 1894, a collection of twelve varieties of *Lettuce* was sent to the Station. Some varieties were from the Central Station grounds, others from the Agricultural Department at Washington. The varieties included Iceberg, Arlington, Curled Simpson, Tennis Ball, Trianon Cos, Grand Rapids, and other standard sorts. Growth was poor in 1894, owing to drought and late sowing, but the plants seeded freely, and volunteer lettuce grew from several varieties, starting with the early rains of 1894–95. These volunteers were fit for the table by January 11, 1895. Many were transplanted, and furnished excellent lettuce for table use till May 1st. Grand Rapids stood the heat best, making plants fourteen inches across, and some were in fair growing condition till the end of June. No water was applied, but the plants had good culture. By sowing lettuce with the first rains, therefore, the farmer can have a supply for his table during five or six months. Lettuce sown in March is hardly more than ready for use before the dry weather. A little garden irrigation from a windmill would carry the season through the year.

Tomatoes do fairly well out of doors, though the fruit is small. They must be started under glass, and cannot be planted out until the late frosts are over. Even after May 1st tomato vines have been severely nipped. The season is very short, as the November frosts usually destroy the vines. East of the Salinas, in the Santa Lucia Mountains, tomatoes, with a little shelter, will bear fully two months longer than at the Station. Among the varieties tested were Volunteer, Matchless, Acme, Aristocrat, Dwarf Champion, Ponderosa, Trophy, Golden Queen, Canada Victor, and Early Michigan. On March 11, 1895, tomato seed of these varieties was sowed under glass. The plants were planted in the garden April 25th. A small plot in the garden, near the stable, was prepared with 2½-inch tile, laid for sub-irrigation, and lath frames were used to protect the plants when necessary. The garden hose could easily be turned into the projecting ends of the tiles. Tomatoes were abundant here all summer, and on November 20th the vines were still in growing condition. For field culture, the Early Michigan and Perfection varieties are as good as any in this district. The large, late varieties are of little value here. In 1894, Ponderosa and Trophy did not ripen fruit till October 15th, and the vines were frozen December 1st. On April 24, 1895, four kinds of tomatoes were planted in the field (no irrigation). Perfection ripened fruit first, August 10th; Golden Queen ripened August 21st; Livingston's Favorite ripened August 15th, and Advance on the same date.

Radishes of all the leading varieties were sown in the spring of 1894. The drought shortened the season of all. The Giant White Stuttgart, a summer variety, was decidedly the best, remaining crisp and excellent until autumn. Under the circumstances (total rainfall less than six inches, and no irrigation), this conclusively shows that the upland farmers can easily add the radish to their summer gardens. The largest roots of this variety were four inches in diameter, but still solid to the center. The frosts of March 14, 1895, severely injured all the radishes.

Garden *Beets*, *Carrots*, *Parsnips*, and *Turnips*, particularly of the Swedish or Rutabaga class, are as easily grown here as lettuce, if sown very early. *Peas* require the same management. *Beans* have not done well.

Jersey Kale continues to prove hardy, and withstands the dry summers better than any other *Brassica*.

Onion sets planted January 12, 1895, made green onion tops fit for the table by March 15th. By making a seed-bed in the autumn, all the hardier onions can easily be grown here, though they are not large—two and a half to three inches in diameter being the average size.

Tobacco, sown in the open ground May 16, 1895, made healthy plants two and a half feet high. Varieties sown were Connecticut, Havana, Hester, and Gold Leaf. Plants started under glass ought to make a fair quality of the light-colored grades of tobacco.

Cauliflower in seed-beds, ready to transplant, and about four inches high on March 14, 1895, were all killed by frost of that date. *Cabbages* of same size were badly hurt, and were of no value.

Potatoes are often worth planting for an early crop, even on the dry uplands. Many persons neglect this important part of the farm garden. On March 21, 1894, nine varieties were planted. Of each variety a row twenty-four feet long was planted, hills two feet apart. McLaughlin, ripe July 26th, yielded five and a half pounds of potatoes (gophers destroyed half the row); Peerless, ripe June 30th, yielded thirteen and a half pounds; Early Peach Blow, dug July 6th, yielded eight pounds; Alexander's Prolific, dug June 28th, yielded twelve pounds; Hess, dug June 28th, yielded thirteen pounds; White Pearl, dug July 7th, yielded twenty-two pounds; Beauty of Hebron, dug July 6th, yielded fourteen pounds; Dandy, dug July 8th, yielded thirteen and a half pounds; Ohio, dug July 10th, yielded twelve pounds. The best of the nine varieties was the White Pearl.

Muskmelons and *Watermelons* have been well tested in the field. With good culture, it is possible to raise melons in most seasons, but the season is short. An excellent muskmelon, known as Polish (seed obtained from a correspondent of the Central Station), withstands drought better than any other variety tested. The first melon of this variety was picked August 20th.

DAMAGE BY SQUIRRELS, GOPHERS, BIRDS, ETC.

Gophers and squirrels have been troublesome since the Station was founded, and particularly so in 1894, when the adjacent farmers, losing their crops by drought, stopped poisoning these pests early in the season. Almost every day colonies of squirrels moved over into the Station orchard or garden, to feed on the green leaves. The foreman was kept busy putting out poisoned wheat, and trapping gophers. Four or five trees were destroyed in the orchard. One rare species of large field gopher makes little surface sign, often digs a long distance without raising the earth, and does more damage in the orchard than a dozen of the common gophers. This gopher is fond of girdling even large trees. One individual has been known to destroy six or seven apple trees, of which they are very fond.

The large California wood-rat was formerly very troublesome here, and a few are still poisoned with the field squirrels.

Linnets, blue-birds, and blue-jays predominate in the flocks of small birds which, every fruit season, descend on orchard and vineyard.

EXPERIMENT WITH MULCHES AT PASO ROBLES STATION.

During the winter of 1893–94 very little rain fell in the upper Salinas country, and crops of every description suffered, particularly east of the river, on the high rolling plains, where farmers and stockmen often have to sink wells from 110 to 200 feet for a permanent supply of water. In this region, no wheat and very little hay was obtained, and the orchards suffered greatly, casting their fruit and leaves to the ground in many cases and making no new wood. Long before midsummer of 1894, it became evident that neglected orchards could with difficulty be saved, even at the loss of the fruit crop; but the orchard at the Experiment Station, and also the vineyard, were easily carried through the season by thorough and constant cultivation.

This Station orchard, as a whole, made a fair average growth, and had it not been for the late spring frosts, would have produced a large crop of fruit. As it was, the peaches and nectarines bore very well, and did not appear to suffer from the drought.

An experiment with mulches was carried out in the vineyard and in the peach orchard, five plots in all being treated. The plots were each of about one tenth of an acre, and on very similar soil.

Plot 1, in the vineyard, was mulched with fresh stable manure to a depth of three inches upon a well-cultivated surface. The manure was spread at intervals between April 13th and April 20th.

Plot 2, in the vineyard, adjoining the foregoing, was simply marked out for continued cultivation, so that the mulch consisted of earth, the cultivator being set to keep its depth at five inches; and it was cultitivated four times during the summer, always in the evening or early morning.

Plot 3, also in the vineyard, was mulched with old, rotten straw to a depth of six inches, as it was thought that the straw would hold much less moisture than the manure, and should be of greater depth. This was applied between April 20th and May 1st.

In the peach orchard, plot 4 received fresh stable manure three inches deep, spread at intervals from May 1st to May 10th.

Plot 5, also in the peach orchard, corresponding with plot 2 in the vineyard, consisted of a soil-mulch five inches deep, and cultivated four times.

Since there were some showers after May 10th, the slight differences in the spreading of the mulches on plots 1, 3, and 4 were probably minimized.

September 17th, while the maximum daily temperature of the week ranged from 90° to 98° Fahr., and the relative humidity was down to 16 per cent, the amount of moisture left in each of the mulched plots was determined. Taking the center of each plot, removed as far as possible from outside influences, a column of earth was removed, and the moisture approximately determined in each cubic foot, to a depth of four feet in two cases, and of three feet in the others. Each cube was weighed as soon as dug, the soil being shaded as much as possible. After being weighed, when first dug, the soil of each cube was broken up and spread in the hot sun. The amount of humidity in the atmosphere was so slight that the proportion of moisture to weight varied very slightly from what it would be if the soil had been kiln-dried.

The following table shows results:

COMPARATIVE VALUE OF MULCHES.

Table showing comparisons between mulches in orchard and vineyard, at Paso Robles Station, during the season of 1894. Total rainfall, 5.70 inches. Very dry, indeed. Hay and grain crops a failure throughout the district.

Material.—Soil and Mulch.	Weight of Cubic Foot when Taken, in Pounds and Decimals.	Weight of Cubic Foot, Air-Dried, in Pounds and Decimals.	Moisture, in Pounds and Decimals.	Proportion of Moisture to Weight.
(1) Vineyard soil.... Mulch of fresh stable manure, 3 inches deep.	Top foot.... 95.625	Top foot 92.250	3.375	.0365
	Second foot. 108.000	Second foot. 104.625	3.375	.0309
	Third foot .. 111.937	Third foot .. 108.000	3.937	.0364
	Fourth foot. 110.250	Fourth foot. 106.312	3.938	.0370
(2) Vineyard soil.... Mulch of cultivated earth, 5 inches deep; cultivated four times.	Top foot.... 89.437	Top foot 87.750	1.687	.0192
	Second foot. 92.250	Second foot. 90.000	2.250	.0250
	Third foot .. 114.750	Third foot .. 111.847	2.903	.0259
	Fourth foot. 112.781	Fourth foot. 109.969	2.812	.0255
(3) Vineyard soil.... Mulch of rotten straw, 6 inches deep.	Top foot 87.187	Top foot 84.937	2.250	.0264
	Second foot. 95.625	Second foot. 93.656	1.969	.0202
	Third foot .. 114.167	Third foot .. 110.812	3.355	.0302
(4) Peach Orchard soil .... Mulch of fresh stable manure, 3 inches deep.	Top foot 91.125	Top foot 90.000	1.125	.0125
	Second foot. 111.937	Second foot. 109.687	2.250	.0205
	Third foot .. 109.125	Third foot .. 106.031	3.094	.0291
(5) Peach Orchard soil .... Mulch of cultivated earth, 5 inches deep; cultivated four times during the summer.	Top foot 97.875	Top foot 96.750	1.125	.0116
	Second foot. 112.781	Second foot. 110.812	1.969	.0177
	Third foot .. 105.750	Third foot .. 104.062	1.688	.0162

There is no check-plot to the above table, because the entire orchard and vineyard were cultivated throughout the summer, in order to keep them alive. The foreman reports that he could see no difference in growth between the general orchard and vineyard and the portions embraced in these experiment plots. But when he dug the cubes, there was quite a difference manifest. The least moisture visible appeared to him to be in the fourth foot of the second plot, and the most in the third and fourth feet of the first plot. As the table shows, his observation was correct in regard to the latter particular, but erroneous respecting the former, as plot 5 was much the worst throughout.

The observations taken would appear to show that a mulch of fresh stable manure, applied early in the season, with light showers afterwards to compact it, may be from 50 to 75 per cent better for retaining moisture than a mulch of cultivated earth (the ordinary tilth of our orchards). It would not be wise to press this point too far in practice, because, as I have said, the late showers, although less than a quarter of an inch of rain fell, may have made considerable difference.

Nevertheless, owners of small orchards and gardens, especially on light soils, where the manure itself would be particularly beneficial, should take note of this experiment. It is hard to see, however, why the manure in the peach orchard should hold so much less moisture than it did in the vineyard, unless it is explained by the undoubted fact that the peach orchard was in more active growth, needing and being able to utilize more of the moisture in the soil. This would also seem likely from observation of the earth-mulch in the peach orchard as compared with the earth-mulch in the vineyard, the proportion of loss being somewhat similar.

The top foot of the earth-mulch can never be expected to contain as much moisture as the top foot under any other kind of mulch, because five inches of the said top foot is itself the mulch, and whenever it is stirred up it loses a large part of its moisture. Allowing for this, the moisture appears to be more evenly held underneath the earth-mulch than underneath either the straw-mulch or the manure-mulch. There is little variation, proportionately, between the second and third feet in the case of the earth-mulch, and, it is probable that, in a column of ten or twelve feet in depth, extending, say, to the gravel which underlies our best orchard land, there would not be very much difference between the total of the moisture held by the earth-mulch and the moisture held by any surface mulch, such as straw or manure.

C. SAN JOAQUIN VALLEY CULTURE STATION.

One mile southeast of Tulare City, Tulare County.

By Charles H. Shinn.

Since the issuance of the last annual report, the work at this Station has continued along the same lines. The many and varied problems arising in relation to the management of alkali soils have received the especial attention of the Central Station staff. The most recent bulletin, issued in August, 1895, on the "Distribution of the Salts in Alkali Soils" has been widely circulated. In the present volume, readers are referred to the article under the above title, on page 37. The reclamation of alkali lands on the one hand; also, the discovery of useful plants which will thrive upon them in their present unprofitable condition, are more and more clearly recognized, by the people of California, as objects of prime agricultural importance. In the past year there has been a notable increase of public interest and confidence in the work of the Tulare Station, as evidenced in numerous articles which have appeared in local and city newspapers respecting the Station and its operations.

At the close of the year 1895, the alkali chart printed on page 402 of the previous report still remains reasonably accurate, though continued observation enables us to more closely define some of the alkali patches, which vary in destructive force according to the rainfall and the season. There is some increase of alkali in those portions of the vineyard subject to some seepage from the adjacent irrigation ditch. The application of gypsum has neutralized the "black" alkali to a considerable extent where barley failed two years ago, and has decidedly helped the orchard.

Australian saltbush (*Atriplex semibaccatum*) was sown, in the spring of 1895, quite extensively on some of the worst alkali places, and is doing excellently there. Transplanted seedlings do not succeed so well in such spots, but are entirely safe in medium grades of alkali.

The general appearance of the Station is all that could be expected or desired. It has many visitors, who go away satisfied that great good is being accomplished.

Irrigation.—Very little irrigation has been necessary, except to assist in reclaiming alkali land, as described in the last report (page 145). Some water is necessary in the nursery and garden. A line of three-inch pipe has now been laid from the pump to the northeast corner, with branches, so as to reclaim, by gypsum and flooding at intervals (as previously described), the worst pieces of strong "black" alkali soil in the orchard and hayfield. There is about an acre of land of this grade, scattered in several places, and fringing down to grades which can be ameliorated by top-dressings of gypsum, and by its use about the collars of the fruit trees. Sewer-pipe was used for this irrigation line, as it was much cheaper than iron, and indestructible from alkali, while, at the same time, the pressure is low. A number of stand-pipes permit the water to be taken out at the most convenient points.

Temperature.—The range of temperature at Tulare is greater than was expected when the Station was established, as has been sufficiently indicated in previous reports upon the olive, the orange, and the fig. The following table shows the temperature since the date of the last report:

TULARE TEMPERATURE REPORT FOR FISCAL YEARS 1893–94 AND 1894–95.

	Daily Mean.	Mean Daily Maximum.	Mean Daily Minimum.	Mean Daily Range....	Extreme Maximum, with Dates.	Extreme Minimum, with Dates.
1893—July	82.16°	105.87°	58.45°	47.42°	114° 19, 31	52° 5, 11, 12
August ...	82.87	106.70	59.03	45.67	112 .... 1, 2, 3, 5, 8, 11, 12, 24	52 20
September	70.00	91.80	48.20	43.60	106 1	42 .... 21, 22, 26
October ...	62.80	84.90	40.70	44.20	100 14	32 17
November	55.00	74.46	35.53	38.93	84 27	24 .... 19, 20
December	50.70	65.09	36.32	28.67	80 10	28 .... 3, 22
1894—January ..	47.35	60.06	34.64	25.32	78 13	24 ..... 6, 7, 8, 9, 10
February .	49.85	65.28	34.42	30.86	82 27	26 .... 11, 13, 23
March	55.16	73.42	36.90	36.52	92 28	28 .... 3, 22
April	64.03	83.86	44.20	39.66	102 20	34 17
May	69.22	88.19	50.25	37.94	104 10	36 16
June	70.93	89.13	52.73	36.40	106 30	44 11
July	83.80	106.38	61.22	45.16	112 18	54 16
August ...	83.58	106.58	60.58	46.00	118 27	54 .... 10, 11, 12, 13, 14, 15, 16
September	74.00	95.47	52.53	42.94	108 .... 10, 23	42 .... 13, 14, 28
October ...	64.71	83.35	46.08	37.27	98 6	36 .... 28, 30
November	60.96	82.73	39.20	43.53	94 7	32 .... 23, 29
December	50.88	61.87	39.29	22.58	76 .... 3, 17	28 .... 2, 3, 4
1895—January ..	48.70	57.93	39.48	18.45	70 ..... 10, 30, 31	28 .... 25, 29
February .	56.46	71.57	41.35	30.22	84 .... 21, 27	32 .... 1, 2
March	56.51	72.32	40.71	31.61	86 .... 1, 6	30 .... 14, 15, 16
April	61.26	78.73	43.80	34.93	94 .... 22, 23	28 5
May	68.18	85.87	50.45	35.42	102 ..... 12, 13, 14	40 29
June	80.36	100.20	60.53	39.67	118 ..... 22, 23, 24	42 1

In order to show more clearly the climatic difficulties here, the dates and minimums of the winter and spring frosts since 1892 (four seasons, 34° being the limit taken) are placed in the following table:

WINTER AND SPRING FROSTS, 1892-1895.

Year.	January.	February.	March.	April.	December.
1892	30° 2d, 11th, 14th, 18th, 19th, and 24th. 32° 3d, 13th, 16th, 20th, 21st, 22d, 23d, and 25th. 34° 12th, 15th, and 28th.	32° 9th and 10th. 34° 5th, 11th, and 12th.	34° 29th.	30° 27th. 34° 18th and 28th.	24° 16th and 17th. 26° 11th, 14th, 15th, 18th, and 19th. 28° 12th and 13th. 30° 6th, 7th, and 20th.
1893	28° 21st and 25th. 30° 19th and 20th. 32° 14th, 26th, and 28th. 34° 1st, 10th, 12th, and 24th.	28° 27th. 30° 2d, 6th, 7th, 14th, 15th, 16th, and 28th. 32° 1st. 34° 3d, 13th, 17th, 18th, and 23d.	32° 1st, 10th, 12th, 13th, and 14th.	32° 7th, 8th, and 13th. 34° 11th and 14th.	28° 16th. 30° 6th, 7th, 9th, 10th, and 17th. 32° 5th, 11th, and 31st. 34° 8th, 12th, 15th, 25th, and 29th.
1894	24° 6th, 7th, 8th, 9th, and 10th. 26° 11th. 28° 12th and 19th. 30° 3d, 5th, and 13th. 32° 29th. 34° 4th and 28th.	26° 11th, 13th, and 23d. 28° 14th, 17th, and 22d. 30° 2d, 3d, and 15th. 32° 7th and 8th. 34° 1st, 4th, 10th, 24th, and 25th.	28° 3d and 22d. 30° 5th, 18th, 21st, and 23d. 32° 4th, 7th, 20th, and 24th.	34° 17th.	28° 2d, 3d, 4th, 13th, 15th, 21st, and 31st. 30° 1st.
1895	28° 25th and 29th. 30° 30th and 31st. 32° 3d and 7th.	32° 1st and 2d. 34° 3d, 4th, 6th, and 7th.	30° 14th, 15th, and 16th. 32° 19th, 21st, and 30th. 34° 17th.	28° 5th. 34° 6th.	22° 30th. 24° 27th and 31st. 26° 16th, 18th, 23d, 25th, and 26th. 28° 15th, 17th, 19th, 21st, 28th, and 29th. 32° 2d and 4th. 34° 1st, 3d, and 5th.

Rainfall.—The following table shows the rainfall at the Station for the three seasons 1892–93, 1893–94, and 1894–95:

	1892–93.	1893–94.	1894–95.
	Inches.	Inches.	Inches.
October	.26	.00	.18
November	.39	.05	.02
December	1.51	1.07	2.44
January	.64	1.24	3.25
February	1.20	.38	1.23
March	3.02	.77	.86
April	.33	.09	.60
May	.00	.26	.60
Totals	7.35	3.86	9.18

This was but a small rainfall, and sometimes severely short; but the foreman's thorough cultivation of the soil, and long experience in handling alkali land, have enabled him to grow all the hay needed, and sometimes a surplus. In all the following notes upon crops, tree-growth, etc., "no irrigation" must be understood, excepting when it is otherwise stated.

THE ORCHARD.

The orchard still presents the varied appearance due to different degrees of alkali, noted in preceding reports; but few additional trees have succumbed, and some, under local application of gypsum, have much improved in appearance. The method of using gypsum, as noted in the previous report (page 404), has been continued with good results, and we are able to say with confidence that a small family orchard of well-chosen fruits can be successfully maintained on such soil, at an expense which is not impracticable.

Some trees in the orchard have grown to large size, probably owing to lack of hardpan underneath, quite as much as to a low percentage of alkali; others have only kept alive from year to year. But very fair peaches, apricots, pears, and plums can be grown with applications of gypsum about the collars of young trees when planted. This does not apply to the worst spots of alkali, but only to such as do not contain *above* the average of the tract.

Almonds.—The location is too frosty for almonds, and the trees suffer severely from alkali. Only six of the ten varieties planted in 1889 are now represented, and none of the soft-shell have borne fruit. Almond on prune stock stands the alkali better, but is no hardier. The Bidwell Mammoth tree is now fifteen feet high, and the trunk is nine inches in diameter. There will be no trouble in growing this variety on medium alkali soils.

ALMOND STATISTICS FOR 1894.

Variety.	First Bloom.	Full Bloom.	First Leaf.	Full Leaf.
Bidwell's Mammoth	Feb. 20	Mar. 4	Mar. 4	March 16
I X L	Feb. 15	Mar. 3	Mar. 3	March 16
Harriott's Seedling	Feb. 4	Feb. 22	Mar. 4	March 14
Ne Plus Ultra	Feb. 6	Feb. 18	Feb. 18	March 4
Nonpareil	Mar. 1	Mar. 9	Mar. 9	March 20
Papershell	Feb. 4	Feb. 16	Feb. 27	March 12

Apples.—The apple, according to previous reports, is one of the most susceptible of all the fruits to alkali; but this conclusion must be modified by the observations of the seasons of 1894 and 1895. There has been a decided improvement in the growth of some varieties; as the roots go deeper, the trees seem to take a new start. Northern Spy, Montreal Beauty Crab, and Siberian Crab are now making large and healthy trees. When the gypsum treatment has been continued a little longer, some young apple trees can be planted here, to make a further test. The hot summers are very hard on trees, and the most complete protection of the trunk is necessary. Very few Russian apples have yet been tested at this Station, but the new Volga and Crimean varieties will be planted as fast as obtained.

The following table gives the statistics of the apple orchard. Only seven varieties, it will be noticed, have yet borne fruit:

APPLE STATISTICS FOR 1894–95.

Variety.	In Bloom.	First Leaf.	Full Leaf.	Fruit Ripe.	Yield.
Alexander	March 24	March 24	April 4	July 26	1 lb. 13 oz.
Arkansas Black	No bloom	March 28	April 6		
Bledsoe	No bloom	April 2	April 12		
Cook's Seedling	No bloom	April 4	April 14		
Cooper's Market	No bloom	April 4	April 14		
Ever-bearing	No bloom	April 4	April 14		
Esopus Spitzenberg	No bloom	March 28	April 6		
Excelsior	No bloom	March 30	April 9		
Fameuse	No bloom	March 30	April 9		
Grimes' Golden Pippin	March 28	March 31	April 10	Sept. 18	2 lbs. 13 oz.
Hoover	No bloom	April 4	April 14		
Hyslop	No bloom	March 26	April 4		
Jonathan	No bloom	March 31	April 9		
Keswick Codlin	No bloom	March 30	April 9		
Lincoln	No bloom	March 28	April 8		
Lady Apple	No bloom	March 28	April 9		
Lawver	No bloom	April 3	April 14		
Loy	No bloom	April 4	April 14		
Montreal Beauty	March 30	March 28	April 8	Did not set	
Missouri Pippin	March 28	March 28	April 6	October 4	2 lbs. 9 oz.
Northern Spy	No bloom	April 4	April 14		
Pewaukee	No bloom	April 4	April 14		
Red Beitigheimer	March 30	March 28	April 8	August 7	2 lbs. 14 oz.
Rhode Island Greening	No bloom	March 31	April 12		
Red Astrachan	No bloom	March 26	April 4		
Stump	No bloom	March 26	April 6		
Sonoma	No bloom	April 2	April 12		
Shirley	No bloom	April 4	April 14		
Smith's Cider	No bloom	March 31	April 9		
Shannon	No bloom	March 30	April 9		
Violet	No bloom	April 3	April 12		
Whitney's Crab	March 26	March 28	April 6	August 9	2 lbs. 5 oz.
White Winter Pearmain	No bloom	March 30	April 10		
Wealthy	No bloom	April 3	April 10		
White Astrachan	No bloom	March 30	April 9		
Wolf River	No bloom	April 4	April 14		
Yellow Siberian	March 24	March 24	April 4	August 9	6 lbs. 3 oz.
Yellow Bellflower	No bloom	March 28	April 6		
Yellow Newtown Pippin	March 28	March 30	April 9	October 8	2 lbs. 10 oz.

All but six of the apples which do not bloom are old enough to do so in suitable soil, but suffer so much from alkali that their growth is very slow, and portions of each tree have died. Pewaukee, Sonoma, and Hoover seem especially susceptible.

Apricots.—The larger trees of this valuable fruit are beginning to bear to some extent; Flickinger, Russian, and a few others have not yet borne.

APRICOT STATISTICS (BLOSSOM AND LEAF) FOR 1894.

Variety.	First Bloom.	Full Bloom.	First Leaf.	Full Leaf.
Alberge de Montgamet	March 10	March 17	March 26	April 3
Boulbon	March 11	March 18	March 26	April 3
Breda	March 12	March 19	March 26	April 4
Beauge	March 9	March 16	March 24	April 1
Blenheim	March 9	March 16	March 23	March 31
Canino Grosso	March 20	March 27	April 3	April 10
De Coulorge	March 6	March 14	March 26	April 3
Hemskirke	March 11	March 18	March 26	April 5
Kaisha	March 9	March 16	March 24	April 3
Kell's Peach Apricot	March 14	March 20	March 27	April 4
Luizet	March 10	March 18	March 26	April 3
Large Early Montgamet	March 12	March 20	March 28	April 5
Large Early	March 15	March 22	March 30	April 9
Long Red	March 6	March 14	March 24	April 4
Musch-Musch	March 14	March 20	March 30	April 7
Moorpark	March 9	March 16	March 26	April 3
Oullin's Golden	March 7	March 16	March 25	April 3
Pringle	March 13	March 19	March 26	April 3
Peach Apricot	March 6	March 12	March 22	March 28
Royal	March 6	March 14	March 20	March 29
Routier's Peach	March 13	March 19	March 26	April 3
Russian	March 14	March 21	March 31	April 9
Red Masculine	March 20	March 26	April 2	April 12
Smith's Triumph	March 12	March 18	March 26	April 5
St. Ambroise	March 9	March 16	March 26	April 3
Sardinian	March 6	March 14	March 24	April 3
Viard	March 5	March 16	March 26	April 3

The following table shows the yield of the bearing apricots:

APRICOT STATISTICS (CROP) FOR 1894.

Variety.	Fruit Ripe.	Weight of 12 Fruits.	Circumference.	Weight of 12 Pits.
		Ounces.	Inches.	Ounces.
Breda	June 23	13	5⅛	1
De Coulorge	June 27	18	6	½
Hemskirke	June 25	21	6⅛	1
Kaisha	June 23	18	5½	1
Long Red	June 27	23	6⅛	½
Moorpark	June 30	18	5½	½
Oullin's Golden	June 2	12	5¼	½
Pringle	June 15	23	6⅛	1
Peach Apricot	June 30	12	5¼	½
Routier's Peach	June 12	18	5¼	½
Smith's Triumph	June 16	30	6	1¼
St. Ambroise	June 25	13	5½	½
Sardinian	June 2	12	5½	½

Nectarines.—The nectarine season is notably short here, as is that of the apricot. Boston, Downton, Newington, and Early Violet yielded no fruit in 1894. The following five varieties seem to thrive fairly well, and bear fruit of good size and quality:

STATISTICS OF BEARING NECTARINES—1894.

Variety.	Bloom Period.	Leaf Period.	Ripe.	Weight. 12 Fruits.	Weight. 12 Pits.
				Ounces.	Ounces.
Hardwicke	Mar. 13—Mar. 24	Mar. 24—Apr. 2	Aug. 9	34	2
Lord Napier	Mar. 14—Mar. 24	Mar. 28—Apr. 6	July 28	41	3
New White	Mar. 14—Mar. 24	Mar. 24—Apr. 4	July 28	31	1
Stanwick	Mar. 18—Mar. 28	Mar. 28—Apr. 8	Aug. 28	38	3
Victoria	Mar. 14—Mar. 24	Mar. 24—Apr. 3	Aug. 28	46	2

Peaches.—The peach orchard contains a number of fine trees; the best of these are Crawford's Late, Picquet's Late, and Governor Garland. Three rows in all are very fair peach trees. The rest of the orchard shows the injurious effect of strong alkali. In the following tables from notes kept by the foreman, Mr. Forrer, the size of the average peaches is given, but not the total crop of the tree. In all the varieties which bore, however, this crop was satisfactory. The peach trees, like some of the apple trees, appear to be gaining somewhat in the struggle:

TABLE I.—BLOOM AND LEAF STATISTICS OF PEACH ORCHARD—1894.

Variety.	First Bloom.	Full Bloom.	First Leaf.	Full Leaf.
Amelia	March 14	March 20	March 20	March 30
Beer's Smock	March 15	March 21	March 24	April 6
Belle Douai	March 14	March 20	March 20	April 3
Belle de la Croix	March 19	March 26	March 26	April 3
Bonanza	March 14	March 20	March 24	April 6
Baldwin	March 24	March 31	March 31	April 6
Brevoort	March 19	March 26	March 28	April 10
Belle Bauce	March 13	March 20	March 22	April 3
Canada Cling	March 12	March 19	March 20	March 30
Chinese Cling	March 13	March 19	March 24	April 3
California Cling	March 14	March 20	March 26	April 4
Crawford's Late	March 14	March 20	March 24	April 5
Cooledge's Favorite	March 13	March 20	March 24	April 3
Crimson Beauty	March 20	March 26	March 26	April 4
Dr. Hogg	March 12	March 19	March 24	April 3
Early Rivers	March 19	March 26	March 20	April 3
Early Rose	March 20	March 28	March 20	April 3
Early Alfred	March 20	March 28	March 24	April 6
Foster	March 13	March 20	March 28	April 6
Grosse Mignonne	March 17	March 24	March 26	April 6
Governor Briggs	March 13	March 19	March 19	March 28
Governor Garland	March 17	March 22	March 26	April 6
Grover Cleveland	March 13	March 20	March 24	April 3
Golden Cling	March 20	March 26	March 20	April 2
Hale's Early	March 19	March 28	March 28	April 6
Henrietta	March 14	March 20	March 24	April 3
Indian Blood	March 13	March 19	March 26	April 6
Jennie Worthen	March 14	March 20	March 20	April 3
Large Early York	March 13	March 19	March 22	April 3
Lemon Cling	March 17	March 24	March 24	April 3
Lovell	March 10	March 17	March 20	April 6
Leopard	March 13	March 19	March 19	March 31
La Grange	March 14	March 20	March 22	April 3
Mary's Choice	March 14	March 20	March 20	April 3
Muir	March 14	March 20	March 20	March 30
Morris White	March 17	March 23	March 23	April 3
Mountain Rose	March 17	March 23	March 23	April 2
Magdala	March 20	March 28	March 28	April 6
McKevitt's Cling	March 13	March 20	March 20	April 3
Newhall	March 12	March 19	March 19	April 1
Nichols' Orange Cling	March 17	March 24	March 26	April 4
Noblesse	March 14	March 20	March 26	April 3
Oldmixon Free	March 14	March 20	March 22	April 3
Oldmixon Cling	March 13	March 20	March 22	April 1
Peen-To	Feb. 15	Feb. 23	Feb. 15	Feb. 26
Picquet's Late	March 17	March 24	March 24	April 6

TABLE I.—PEACH ORCHARD—Continued.

Variety.	First Bloom.	Full Bloom.	First Leaf.	Full Leaf
Richmond	March 13	March 19	March 20	March 30
Roseville Cling	March 13	March 19	March 20	March 30
Salway	March 13	March 19	March 19	April 2
Schumacker	March 14	March 20	March 24	April 4
Smock's Late Free	March 20	March 26	March 26	April 3
Stump the World	March 13	March 21	March 21	April 1
Susquehanna	March 12	March 18	March 20	April 3
Scruggs	March 13	March 19	March 26	April 3
Snow	March 12	March 19	March 19	March 28
Tuscany Cling	March 20	March 28	March 28	April 4
Thissell's Free	March 12	March 24	March 24	April 6
Ward's Late Free	March 13	March 22	March 22	April 5
Wheatland	March 14	March 20	March 22	April 1
Wilkins' Cling	March 13	March 19	March 19	April 3
Wonderful	March 15	March 21	March 24	April 6
Yellow St. John	March 12	March 18	March 20	April 3
Yellow Tuscany	March 12	March 19	March 24	April 3

The following varieties did not bloom: Alexander, Brandywine, Red River, Seller's Cling, Briggs' May, Burke Cling, Chair's Choice, Elberta, Ford's Improved, Lemon Free, S. G. French, Late Admirable, Miss Lola, Pansy Pabor. Four of them were too small to bloom; the others suffered too severely from alkali.

TABLE II.—CROP STATISTICS OF THE PEACH ORCHARD—1894.

Variety.	Fruit Ripe.	Weight of 12 Fruits.	Circumference.	Weight of 12 Pits.
		Ounces.	Inches.	Ounces.
Beer's Smock	Oct. 6	50	8	2½
Belle Douai	Aug. 9	36	7⅛	2
Belle de la Croix	Aug. 9	36	7¼	2
Bonanza	Oct. 16	36	7	3
Belle Bauce	July 16	28	7	1
Canada Cling	Sept. 3	120	11½	3
Chinese Cling	Aug. 16	67	8½	1
Crawford's Late	Aug. 29	62	9	3
Cooledge's Favorite	Aug. 1	28	6	4
Dr. Hogg	Aug. 9	32	7¼	1½
Governor Garland	June 18	40	7½	2
Grover Cleveland	Aug. 25	52	3	2½
Hale's Early	Aug. 18	40	7½	3
Henrietta	Oct. 16	96	9½	3
Jennie Worthen	Aug. 2	48	8½	2
Large Early York	July 21	28	6⅝	1½
Lemon Cling	Aug. 29	30	6¼	2¼
Lovell	Aug. 30	62	8½	2½
Mary's Choice	Aug. 11	36	7	2½
Muir	Aug. 28	49	8¼	2
Morris White	Aug. 28	59	8¾	3
Mountain Rose	Aug. 2	50½	8¼	3
McKevitt's Cling	Sept. 22	88	9½	3
Newhall	Aug. 29	74	9	3
Noblesse	Sept. 20	54	8	2
Oldmixon Free	Aug. 2	54	9⅛	2
Oldmixon Cling	Aug. 28	58	8⅛	2
Picquet's Late	Sept. 20	82	9½	3
Richmond	July 30	45½	8	2½
Salway	Oct. 6	96	10	3
Schumacker	Sept. 5	44	7¾	2
Stump the World	Sept. 4	64	8½	2½
Susquehanna	Aug. 18	52	7	3
Snow	Sept. 22	48	8½	2
Thissell's Free	Sept. 8	72	9¼	2
Ward's Late Free	Sept. 8	60	8½	2
Wheatland	Aug. 29	52	8	2½
Wonderful	Oct. 3	50	8	2½
Yellow Tuscany	July 28	65	9⅛	3

Pears.—The data in last report (page 408) remain true, except that the pears, rather more than any other fruit tree, show recuperative energies in moderately alkali soils; and it would not take a great amount of gypsum, properly applied, to insure a stand of pears in many such places.

TABLE I.—Blossom and Leaf Statistics of the Pear Orchard—1894.

Variety.	First Bloom.	Full Bloom.	First Leaf.	Full Leaf.
Beurré Gris d'Hiver Nouveau	March 24	April 2	March 26	April 4
Beurré Clairgeau	March 24	April 3	March 28	April 6
Barry	March 24	April 2	March 28	April 9
Black Worcester	April 2	April 10	April 2	April 10
Belle Lucrative	March 28	April 6	March 28	April 8
Beurré Giffard	March 26	April 6	March 26	April 8
Beurré d'Amanlis	March 24	April 3	April 3	April 12
Beurré Gris d'Hiver	March 28	April 9	April 1	April 12
Clapp's Favorite	March 28	April 6	April 4	April 14
Col. Wilder	March 28	April 5	March 28	April 8
Duchesse d'Angoulême	March 26	April 3	April 3	April 14
Dearborn's Seedling	March 26	April 3	March 26	April 5
Easter Beurré	March 24	April 2	April 2	April 12
Forelle	March 24	April 1	March 26	April 4
Glout Morçeau	March 28	April 6	March 28	April 8
Gansel's Bergamotte	March 28	April 4	April 2	April 10
Jaminette	March 26	April 4	March 28	April 8
Josephine de Malines	March 26	April 4	March 28	April 8
Kennedy	March 26	April 3	March 28	April 6
Le Conte	March 17	March 25	March 17	March 28
Lawrence	March 22	April 2	April 2	April 12
Louise Bonne de Jersey	March 24	April 2	March 28	April 6
Mount Vernon	March 22	April 1	March 26	April 4
Seckel	March 24	April 2	April 2	April 12
Swan's Orange	March 28	April 6	April 4	April 14
White Doyenne	March 28	April 6	March 28	April 12

The varieties which did not bloom at all were André Desportes, Anna Ogereau, Beurré d'Anjou, Bartlett, Beurré Diel, Beurré Hardy, Beurré Bosc, Cole, Conseiller de la Cour, Columbia, Dr. Reeder, Doyenne d'Alençon, De Tongres, Doyenne d'Eté, Doyenne du Comice, Flemish Beauty, Frederick Clapp, Howell, Jean de Witte, Keiffer, Lawson, Nouveau Poiteau, Onondaga, Paradise, Pound, Sheldon, Souvenir du Congrès, Tyson, Van Mons' Leon le Clerc, Vicar of Winkfield, Winter Seckel. Some six of this list were but recently planted, and not of sufficient age to blossom; the others are all succumbing to the strong alkali of the northern end of the pear orchard.

Nineteen varieties are now bearing, and these are tabulated below:

TABLE II.—Crop Statistics of Pear Orchard—1894.

Variety.	Fruit Ripe.	Weight of Two Pears.	Average Circumference.
		Ounces.	Inches.
Beurré Gris d'Hiver Nouveau	Oct. 4	21	10
Beurré Clairgeau	Sept. 22	30	11
Barry	Oct. 16	26	10
Black Worcester	Oct. 4	32	12
Beurré d'Amanlis	Aug. 27	24½	11½
Beurré Gris d'Hiver	Oct. 4	12	8½
Duchesse d'Angoulême	Oct. 4	20	10
Dearborn's Seedling	July 30	5	6⅝
Easter Beurré	Oct. 4	48	13¼
Forelle	Oct. 4	11	8½

TABLE II.—PEAR ORCHARD—Continued.

Variety.	Fruit Ripe.	Weight of Two Pears.	Average Circumference.
		Ounces.	Inches.
Glout Morçeau	Oct. 8	20	11½
Josephine de Malines	Oct. 24	13	8½
Kennedy	Oct. 4	15	9¼
Le Conte	Sept. 22	14	8½
Louise Bonne de Jersey	Oct. 4	14	8½
Mount Vernon	Oct. 4	22	10
Seckel	Aug. 27	6½	6½
Swan's Orange	Sept. 24	17	9½
White Doyenne	Aug. 27	15½	9½

Plums and Prunes.—The Myrobalan and Marianna stocks still stand well on quite strong alkali. The plum orchard is partly on very bad soil, and so uneven that no definite conclusions can be drawn without much more study of the plots.

The best plum tree in the orchard is Ontario on Myrobalan. Measured in the summer of 1895, it stood fifteen feet high, and showed five feet of new growth. Damas Noir on Myrobalan, Cherry plum on its own roots, and Marianna, are nearly as good trees. But the Marianna is much healthier in appearance, and holds its leaves longer than the Cherry plum.

A Petite Prune d'Agen on almond stock has done better than this prune elsewhere on plum stock. It stands fourteen feet high, and shows four feet of new wood.

Among the trees of second size, but still healthy, are Quackenboss, Lawrence, Duane's Purple, and Coe's Golden Drop.

Kelsey does poorly, and so do most of the Japanese plums. As a rule, the fruit of all the plums is of very poor quality here. Red Egg is particularly so, even for that variety. One of the best plums here, in respect to quality, is Bavay's Green Gage. The Damsons are hardy and good bearers in quite strong alkali, so that collections of the leading Bullaces and Damsons are indicated for such localities.

TABLE I.—BLOOM AND LEAF STATISTICS OF THE PLUM ORCHARD—1894.

Variety.	First Bloom.	Full Bloom.	First Leaf.	Full Leaf.
Bulgarian	April 2	April 10	April 4	April 14
Bavay's Green Gage	March 24	April 10	April 2	April 10
Belle de Septembre	March 28	April 6	April 4	April 15
Bryanston's Gage	March 26	April 4	April 3	April 14
Botan	March 13	March 22	March 22	March 31
Botankio	March 13	March 20	March 20	March 30
Blackman	March 26	April 4	March 26	April 9
Cherry	March 12	March 20	March 20	March 30
Caddo Chief	March 19	March 29	March 19	April 4
Coe's Golden Drop	March 28	April 8	April 6	April 18
Coe's Late Red	March 28	April 6	April 6	April 18
Czar	March 26	April 3	April 3	April 14
Columbia	March 24	April 2	April 2	April 14
Copper	March 22	March 30	April 4	April 15
Chabot Blood	March 2	March 12	March 12	March 22
Diaprée Rouge	March 28	April 6	April 6	April 16
Damas Noir	March 28	April 5	April 5	April 16
Duane's Purple	March 26	April 4	April 4	April 16
Damson	April 2	April 9	April 9	April 20
Early Golden Drop	March 26	April 3	April 3	April 15
Fellenberg	April 2	April 14	April 6	April 18

TABLE I.—PLUMS AND PRUNES—Continued.

Variety.	First Bloom.	Full Bloom.	First Leaf.	Full Leaf.
German Prune	March 28	April 6	March 28	April 9
Guthrie's Late	March 28	April 4	March 31	April 12
General Hand	March 26	April 6	March 28	April 12
Green Gage	March 26	April 4	April 8	April 20
Golden Beauty	April 2	April 12	April 6	April 18
Golden Prune	March 31	April 9	April 6	April 14
Hungarian	March 28	April 6	April 9	April 18
Imperial Gage	March 28	April 6	April 6	April 18
Judson	April 2	April 10	April 6	April 16
Kelsey	March 6	March 15	March 20	March 30
Lucombe's Nonesuch	March 24	April 1	March 28	April 10
Lawrence	March 22	April 1	March 26	April 6
Marianna	March 20	March 28	March 28	April 9
McLaughlin	March 28	April 6	April 6	April 18
Monroe Gage	March 28	April 9	April 9	April 18
Masu	March 26	April 5	March 26	April 9
New Large Bullace	March 26	April 4	April 4	April 16
Ontario	March 26	April 6	March 26	April 8
Prunus Simoni	March 10	March 19	March 24	April 4
Prince of Wales	March 20	March 28	March 28	April 9
Petite Prune d'Agen	March 24	April 2	April 4	April 12
Perdrigon Blanc	March 30	April 7	April 7	April 18
Précoce de Bergthold	March 28	April 6	April 6	April 18
Peach	April 2	April 10	April 2	April 14
Pond's Seedling	March 28	April 6	March 28	April 12
Prince Englebert	March 28	April 6	April 6	April 18
Reine Claude de Bavay	April 2	April 10	April 10	April 18
Qackenboss	March 28	April 6	April 4	April 14
River's Early Prolific	March 26	April 4	April 4	April 16
Red Egg	March 24	April 3	April 3	April 12
Robe de Sergent	March 26	April 3	April 3	April 12
Ronald's Fancy	April 2	April 10	April 2	April 14
Silver Prune	March 30	April 8	April 8	April 20
Shropshire Damson	April 2	April 10	April 6	April 16
Tragedy	March 22	March 30	March 26	April 6
Victoria	March 30	April 9	April 9	April 20
Wangenheim	March 28	April 5	April 5	April 16
Washington	March 30	April 8	April 8	April 18
Yellow Egg	April 3	April 12	April 3	April 16
Yellow Gage	March 24	April 3	April 7	April 20

The only plum trees in the orchard which did not bloom were Black Morocco, Clyman, Elmore, Ickworth, Jefferson, Ruby, and St. Catherine. Two of them were recently planted; the others are succumbing to alkali.

TABLE II.—CROP STATISTICS OF PLUMS AND PRUNES—1894.

Variety.	Fruit Ripe.	Weight of 12 Fruits.	Average Circumference.	Weight of 12 Pits.
		Ounces.	Inches.	Ounces.
Bulgarian	July 28	8½	4	½
Bavay's Green Gage	Oct. 6	13½	5	1
Belle de Septembre	Sept. 29	8	4¼	1
Botan	July 18	12½	5	½
Botankio	July 20	16	5⅛	½
Coe's Late Red	Oct. 16	10	4½	½
Czar	July 12	16	5½	½
Columbia	July 16	16	5½	½
Copper	Oct. 6	7	4	½
Chabot Blood	Sept. 29	10	4½	½
Diaprée Rouge	July 30	8	3⅝	½
Duane's Purple	July 18	14	4½	½
Damas Noir	July 19	3	2	¼
Damson	Sept. 8	6	3½	½

TABLE II.—PLUMS AND PRUNES—Continued.

Variety.	Fruit Ripe.	Weight of 12 Fruits.	Average Circumference.	Weight of 12 Pits.
		Ounces.	Inches.	Ounces.
Early Golden Drop	June 12	6	3½	¼
German Prune	Sept. 29	6	3½	½
Guthrie's Late	Aug. 9	12½	4½	½
Golden Beauty	Sept. 6	3	3	¼
Golden Prune	Aug. 18	18	5½	½
Imperial Gage	Aug. 16	10	4½	½
Judson	Sept. 12	13	5	1
Kelsey	Sept. 29	13	4¼	1
Lawrence	Aug. 16	19	5½	1
McLaughlin	July 9	16	5¼	½
New Large Bullace	Oct. 16	6	4	½
Ontario	July 7	24	6	1
Prince of Wales	Aug. 24	10	4½	¾
Petite Prune d'Agen	Sept. 3	8½	4½	½
Perdrigon Blanc	Sept. 29	5	3½	½
Précoce de Bergthold	June 30	2½	3⅛	¼
Pond's Seedling	Aug. 24	21	5¾	1
Prince Englebert	July 30	16	5⅛	½
Quackenboss	Aug. 17	18	5½	1
River's Early Prolific	June 30	8	4¼	¼
Red Egg	Aug. 20	10	4¼	½
Robe de Sergent	Aug. 27	8½	3¾	½
Silver Prune	Sept. 8	22	5½	1
Shropshire Damson	Sept. 8	3½	3	½
Tragedy	July 21	12½	4¾	½
Victoria	Aug. 24	20	5½	½
Wangenheim	July 28	6	2½	½
Washington	Aug. 2	18	5½	1½
Yellow Gage	July 17	12	4⅝	½

The Fig in Tulare County.—After five years' study of the varieties of fig planted here, and several previous reports (A. E. S. Report 1890, page 288; Report 1891–2, pages 147–157; Report 1892–3, pages 411, 414), the best kinds for this district can be ascertained with some certainty. The lists given below only partially apply to the foothills, as at Porterville, and not at all to Southern California, where continued observations indicate quite a different selection.

The best figs (quality of fruit not considered) for strong and excellent growth of tree, even in medium alkali, are the following, in the group-orders as named: (1) White Adriatic, Bourjassotte Gris, and Ronde Violette Hâtive; (2) Brown Ischia, Dorée Narbus, Rocardi, De Constantine; (3) Du Roi, Black Marseilles, Col di Signora Bianca, Royal Vineyard; (4) California Smyrna and Petrovaca.

The best fig trees for close, compact type, good bearers, are the following, in the order named; all are desirable: Hirtu du Japon, Osborne's Prolific, Dalmatian, Pasteliere, Abondance Précoce, Royal Vineyard.

The best of these six are Hirtu du Japon and Pasteliere, as far as bearing is concerned, in this locality; but all are valuable. Du Roi, also a most excellent fig and a heavy bearer, has not the compact growth of the varieties above listed; otherwise it ranks among the very best of the white-fleshed, delicate figs.

It is observed that as the tree of Dorée Narbus attains age, its fruit is larger and better than before. It is a more useful variety, in this respect, than had been supposed. The fig is excellent in quality, though still of about the third rank in respect to size. But the extreme hardiness of this variety, as tested for so many years here, makes it very desirable for family orchards, and it should become better known.

FORAGE PLANTS.

Australian Saltbush (*Atriplex semibaccatum*).—This, by far the most valuable of the saltbushes so far tested at the Station, has now been distributed by the department for two seasons, and is everywhere recognized as a plant of unique importance to California agriculture. It will probably become a naturalized pasture plant in many districts, as much as alfilaria and alfalfa. If the Tulare sub-station had done nothing else since its establishment, except the testing and introducing of *Atriplex semibaccatum*, its cost would have been amply repaid. Reports upon this plant appear elsewhere in this volume, cn page 319.

GROWTH OF TREES, SHRUBS, AND OTHER PLANTS ON ALKALI SOILS.

Little has yet been published anywhere respecting the behavior of various species of shade and forest trees, shrubs, vines, and other economic or ornamental plants, when grown on strong alkali soils, such as those of the Tulare Station. But it is evident that the subject is important, for great differences in the resistant powers of different species of plants are shown, and one of the most promising lines of future study is in this direction. Experiments are now well under way, and will be continued until every species of economic value has been tested in respect to its endurance of alkali. The following notes include only such trees, shrubs, etc., as have been tested for several years; many small plants still in the nursery (though on alkali soil) require more complete tests.

A simple classification of black alkali soils, according to native growths, would be as follows: (1) Extremely bad, without any vegetation, usually crusted with almost pure alkali salts; if somewhat lighter, containing patches of various "alkali weeds," some of which, as the *Nitrophila occidentalis*, are also found on tide lands. If the alkali is still less than as above, the "sea-blights," *Suæda diffusa* and *Suæda suffrutescens*, which have narrow, fleshy, linear leaves, purplish in the young growth, will be found there. (2) Strong alkali soils, which usually surround the extremely bad "alkali sinks," have as their principal vegetation "salt grass" (*Distichlis maritima*), a perennial resembling, in appearance, the well-known Bermuda grass. (3) As the amount of "black" alkali decreases, we find, but still with the salt grass, *Atriplex phyllostegia*, a large, white, native tumble-weed; several species of *Bigelovias*; the winter sage (*Eurotia lanata*), and, lastly, some native clovers. Such land is already of considerable value, and its further reclamation is comparatively easy.

Kolreuteria paniculata.—This small tree, often used for ornament, has very remarkable powers of resistance. A tree removed from ordinary garden soil in Alameda County, and planted near the Station sump, in the strongest "black" alkali, has grown three feet in twelve months, and is now four feet high and in entire health. The alkali here is heavily crusted on the surface of the soil, and drains into the hollow. Moreover, all the manure from the stable (which cannot be used on alkali soil) is dumped into this hollow, increasing the difficulty. The only culture plants which will grow here, so far as tested, are *Atriplex semibaccatum* and *Kolreuteria paniculata*. There is no weed or grass growth, or any other vegetation in this hollow, except the *Nitrophila.* The *Kolreuteria*, in California, makes a tree with a trunk of a foot in diameter, and is perhaps thirty or forty feet high; the timber is hard, and useful for small turnery, also for firewood. It is a native of China, and is found in many old gardens in the Atlantic States. The *Kolreuteria* is best propagated from seeds or root cuttings.

Tamarix gallica, and other species of *Tamarix*, show remarkable resistant powers. The *Tamarix*, or Tamarisk tree of the Orient, furnishes one of the most durable and hardest of woods. Though but a small tree, it is very desirable on account of its graceful and feathery growth, handsome flowers, and high fuel-value. All the species grow as easily as willows from hardwood cuttings, planted in winter. Charcoal of the best quality is made from *Tamarix* wood. Copses of both *Tamarix* and *Kolreuteria* can, therefore, be easily established on the strongest of "black" alkali soils, those graded previously as "extremely bad." The *Tamarix* will grow from pieces of the spring-growth of wood, taken as soon as the leaves fall, the following winter. Pieces only two inches long will readily root in sand or good soil, but if planted in alkali, the cuttings should be twelve inches long.

European Sycamore.—This fine tree (*Platanus orientalis*) has lately attracted much attention as a stately and hardy street tree, thriving under many adverse conditions. It is far superior in this respect, and in point of value of the timber, to our native sycamore. It will grow from cuttings and seed; is a very rapid grower, and deserves to be extensively planted, especially in hot, dry districts. It also withstands the sea winds better than the lindens and elms. But the chief value of this fine tree will be in the alkali districts, where it may safely be recommended for extensive planting, as the largest alkali-resisting tree yet tested. Its fuel-value per cord will be somewhat greater than our native sycamore, while its timber-value, under proper conditions, should be considerable, the trunk being straight and tall, while the wood is extensively used in Europe for domestic utensils and furniture.

Three trees of European sycamore are growing at the Tulare Station, and the largest stands upon extremely bad alkali soil. This tree, six years old from seed, when measured in the summer of 1895, stood twenty-six feet high (six feet to the lowest branches), and its girth three feet from the ground was twenty-four inches. It has been five years planted at the Station. An acre of such trees, set close, so as to make clean trunks, would probably be ready for thinning, and furnish considerable firewood by the sixth year. The tree, as already noted, will thrive where it is too cold for any Eucalypt, and will grow on alkali soil too strong for *E. globulus.*

A second European sycamore, on more sandy soil, but still containing some alkali, same age as tree above described, stands eighteen feet high, and girths fifteen inches. A third tree, same age, on still lighter sand, is sixteen feet high, and girths twelve and a half inches.

Poplars.—A number of species of the Poplar are quite suitable for planting in the alkali soils. The common Lombardy and South Carolina poplars, like the largest willows, are often grown in such locations. *Populus Fremontii* is particularly resistant. *P. monilifera* is more useful for paper pulp and timber. A fine Russian species, *P. Petrofskii*, introduced by Professor Budd of Iowa, probably furnishes the most valuable timber of the entire family; and, as it is a native of an alkali district, is almost certain to be resistant. *P. Canadensis* is also valuable in these soils. Poplars (Lombardy), near the Station, have grown eighteen feet in three years from cuttings.

Camphor Tree.—One of the most gratifying successes at the Station has been that of the camphor tree of Japan (*Camphora officinarum*). A tree, in moderately strong alkali soil, planted five years ago, is now fifteen feet high, and fully as wide across the base—a fine, compact, healthy tree.

Strawberry Tree (*Arbutus unedo*), five years old, six feet high, is healthy, and endures alkali fairly well.

Oaks.—A cork oak, five years planted, stands eight feet high, with a trunk six inches in circumference; but the location seems favorable, and the amount of alkali is not high.

English Oak, No. 1, five years planted on sandy, alkali soil, is but four feet high; much injured by cattle, as it is outside the Station fence. No. 2, five years planted, is eight feet high, on the alkali of medium grade. No other oaks have yet been systematically tested.

The native white oak (*Q. lobata*) often stands well in very strong alkali basins. There is reason to think that *Q. cerris*, a South European oak, will surpass, in rapidity of growth, the English oak (*Q. pedunculata*) under these hard conditions. The timber of either will certainly be more valuable than that of the native valley oaks.

Juglans Family.—The English walnut, so called (*Juglans regia*), in all its varieties, including the strong-growing Persian, is impatient of alkali, and the dry, hot summers. All trees of this species are dying fast. *Juglans Californica* does better, but still suffers from the heat; though of medium resistant quality, as regards alkali. No. 1, on heavy soil (alkali), five years planted, stands twelve feet high, with a girth of trunk of fourteen inches; leaves are rather burnt and yellow in midsummer. No. 2, five years, on sandier soil, stands but eight feet high. No. 3, also on sandy soil, same age, stands thirteen feet high, with girth of trunk of fifteen inches; leaves healthy. *Juglans nigra* dislikes alkali, and shows a very slow growth as compared with the allied *J. Californica*. The pecan (*Carya olivæformis*), curiously enough, stands alkali and heat better than any of the walnuts, except *J. Californica*, but its growth is slow here.

Mulberries.—The collection at the Station is large, comprising all the leading varieties. Some are now among the largest shade trees on the grounds. The Japanese "Lhoo" variety is one of the best for rapid growth. The Black Persian is of medium growth. The Russian does extremely well, making a more rapid and tree-like growth here, on alkali soils, than at the other Stations, or elsewhere in the State. In hardiness it is unexcelled among the mulberries. It is already planted to some extent in portions of Antelope Valley, with poplars and locusts, for firewood and fencing, and will be found very useful. The American mulberries thrive on medium grades of alkali, but are probably less resistant than the Oriental forms.

Maples.—Most of the Pacific Coast and Japanese large-leaved forms of maple, so far as observed on strong alkali soil, are a failure. *Acer macrophyllum* has done well in one instance. European and silver-leaved maples and the *Negundos* do much better. *Negundo Californica* is often seen as a shade tree in alkali districts.

Elms.—One of the largest and finest shade trees on the tract is an elm, whose trunk girths twenty inches. It spreads its boughs across a circle whose radius is twenty-eight feet, and rises to a height of eighteen feet. This is a slippery elm (*Ulmus fulva*), six years planted. A Huntington elm stands only eight feet high, after five years of growth. A cork-bark elm does better, and makes a fair growth. *Ulmus Americana* does poorly, as the leaves burn.

Locusts.—The common white-flowered locust (*Robinia pseudacacia*) is often planted in these soils, and makes a good, strong growth. It is very commonly, with *Melia Azedarach*, the only shade tree used. The pink-flowered species (*Robinia viscosa*) also thrives on quite strong alkali, and blooms abundantly there. The honey locusts (*Gleditschias*), while not growing very large, are healthy, and might be used for cheap fences on an extensive scale in the alkali districts.

Carob.—The true carob (*Ceratonia siliqua*) is fairly well adapted to resist alkali, and its thick, firm leaves have but few equals in point of enduring the hot sun. A five-year-old tree, on rather bad, sandy, alkali soil, is now ten feet high. It might be wise for some large land-owner to plant an acre of such land to this tree, whose fodder value is so well established. It does very well, indeed, on mesa land at Santa Monica (without irrigation). It is well adapted to many of the dry California hillsides.

Eucalypti.—There is much difference in the behavior of various species of eucalypts on alkaline soils. The eucalyptus family contains trees of the desert and the swamp, of the upland and the lowland. When the entire list has been tested here, it is likely that some very useful species will have been discovered for these lands. At present the only eucalypts upon which we can report are *E. amygdalina*, *E. Gunni*, *E. eugenoides*, *E. rostrata*, *E. viminalis*, and *E. globulus*.

The largest and best of these is a specimen of *E. amygdalina*. Another of the same species has grown but poorly, and probably is on hardpan. The best tree of this species stands thirty feet high, and girths twenty-four inches at five years of age.

E. Gunni, a species which, here at least, breaks badly in the wind, stands eighteen feet high, and girths fifteen inches at five years.

E. rostrata girths forty inches, and stands forty feet high. A good species for alkaline soils, and quite hardy.

E. viminalis girths thirty-six inches. A good tree, and sturdy, but not quite equal to *E. rostrata*, though about as hardy and better here than *E. globulus*.

E. resinifera is worth testing on alkali soils.

Grevillea robusta.—This tree, on medium alkali, five years planted, is now eighteen feet high, and has a trunk eighteen inches in girth. In heavier alkali, the leaves suffer. *E. Hilli* is still more sensitive.

Palms.—The Phœnixes are all noteworthy for resistance to alkali. There is nothing better, in this regard, than the wild date (*Phœnix canariensis*). The named varieties of African and Arabian dates, such as Seevah, Sultaneh, and Fard, show notable differences is this respect. The Seevah is particularly resistant; the Fard is also excellent. These two are probably among the best.

Plants of California fan palm (*Washingtonia filifera*), which came to the Station five years ago in two-inch pots, and were set in alkali soil, now measure as follows: No. 1, in sandy alkali, twelve feet high, and the same distance across; girth of trunk, four feet. No. 2 (same age) girths nine feet. The latter is on heavy soil, medium amount of alkali.

Conifers.—It is difficult to find species of conifers which will thrive on alkali soils. The *Juniperus Phœnicia* will succeed very fairly under these conditions. *Pinus canariensis* has done quite well. The Monterey pine grows to large size in extremely salty and wet lands, but has not been thoroughly tested on black alkali. The Italian Cypress shows some resistance. The finer California timber species are sensitive, as a rule, excepting *Pseudotsuga Douglasii*, which has thriven where ordinary orchard trees perished.

Casuarinas.—This class of Australian timber trees contains several useful species for planting on alkali soils. *C. quadrivalvis* is excellent.

Shrubs.—A trailing species of *Kunzia*, from Australia, not yet fruited, thrives on strong alkali. The well-known old *Fabiana*, with its spikes of white flowers, is entirely successful. So are the oleanders, the crape myrtle, and the lemon verbena (*Aloysia*). The smoke tree (*Rhus cotinus*) is very desirable under these conditions, and it is probable that other species would thrive equally well.

Vines.—If the *Pueraria Thunbergiana*, a fine starch plant of Japan, of highly ornamental growth, can be protected from the full sun, it will stand considerable alkali in this district. So will the wistarias and the jasmines. The abutilons, which may be either trained against a wall, or treated as a shrub, are fairly resistant, though the malvas, as a class, show very little resistance. The trumpet creeper (*Tecoma radicans*) has rather surprising capacities in this direction, and will probably thrive where the ipomeas fail. Some passifloras have done quite well.

Garden Plants.—Among those which are indicated for the stronger alkali soils are the following: Portulaccas, calandrinas, and others of the ornamental purslanes; ornamental-leaved beets; the hardier mesembryanthemums, ice-plants, etc.; the various yuccas; verbenas; cannas; violets (if well shaded); geraniums; several silenes; hollyhocks; tuberoses, and *Amaryllis belladonna*.

Fruit Trees.—In order to make this brief review more complete, we add some notes upon the comparative resistance of various species of fruit trees. One of the most resistant of all is the pomegranate; all species, without visible difference, excepting that the double-flowered ornamental sorts are less sturdy.

The common quince is a very resistant tree, as might have been expected. The Japanese species sheds its bark, and is not altogether a success here.

It is difficult to tell which is hardier, the quince or the pear. Both species are better resistants than either the fig or the olive.

The plum ranks next after the pear. No fruit trees, excepting pomegranates and mulberries, however, can safely be planted on any strong alkali soils. Even the quince and the pear should be limited to low or medium grades of alkali. Trees will grow fairly in soils that produce only worthless fruit. But both mulberry and pomegranate fruits are good when grown on alkali soils.

The preceding notes might be indefinitely extended, if the object were merely to list those species which are known to succeed more or less easily in the alkali districts. The Texas umbrella tree (*Melia Azedarach*), for instance, is widely planted and seems to grow where few other species thrive, but it has not been critically studied at the Station. Many *Atriplexes* are remarkable resistants of alkali. *A. hortensis*, of Algeria, the Orach of the French vegetable gardens, grows six or eight feet high in a single season, in strong alkali soil. But *A. semibaccatum* is much the more desirable forage plant.

D. SOUTHERN CALIFORNIA CULTURE STATION.

In the Chino Valley, between Pomona and Chino.

By Charles H. Shinn.

The greatly increased interest in Farmers' Institutes in the more progressive districts of California, is reacting favorably upon our Experiment Stations, and upon none so much, at present, as upon the last established—Southern California. Previous reports have alluded to the extreme accessibility of this Station, which is easily reached from Ontario, Chino, and Pomona; two more railroad lines will soon be built across Chino Valley, to aid in its development. The number of visitors to the Station has considerably increased, and it is proposed to hold a Farmers' Institute upon the grounds some time in 1896, so as to specialize instruction and extend more widely a knowledge of the work of the Experiment Station, as delegates from various Farmers' Clubs are expected to be present.

The General View.—The leading lines of work at the Station, since the last report, have been experiments with the orchard, and with sugar beets and other crops on the ten-acre tract of moist land. Notes upon the latter appear elsewhere, with illustrations, ample analyses, and discussions from Professors Hilgard, Loughridge, and others. (See page 71.)

The laying out of the grounds has been nearly completed. In the summer of 1895, Mr. George Hansen, foreman of Amador Foothill Station, was sent to the Southern California Station to survey and plot the grounds immediately surrounding the house, and to make suggestions respecting the ornamental department. Mr. Hansen had had some training in this direction in Europe, and his charts of the Foothill Station were framed for exhibition in the display of the Agricultural Department at the Midwinter Fair. The plans as completed by Mr. Hansen, and modified in minor details by the department, provide for a simple, effective, and dignified arrangement of the grounds around the buildings, which yet retains and accentuates the Experiment Station idea. The large and beautiful water reservoir is made a prominent feature, and given a distinctive background; there is a small aboretum, chiefly of rare and semi-tropic shrubs and trees; a garden of economic plants, which will become one of the most distinctive features of the Station, occupies space that has hitherto been unutilized; a poor, gravelly corner, where crops have failed, has been filled with cacti, yuccas, agaves, and similar species from the desert.

There has never been a time, since the establishment of the Station, when more effective work has been done by the foreman and his laborers, than at Southern California during 1895. The asphaltum walks have been nearly finished, and the grounds laid out in a most satisfactory manner, at a reasonable cost. The foreman, Mr. J. W. Mills, has fitted up some chemical apparatus, in the upper room of the tank-house, which has proved very useful. He has attended several Farmers' Institutes, and Farmers' Club meetings; is a member of a Botanical Club in Los Angeles; visits the leading nurseries, and may be considered a growing man in his line of work.

Rainfall.—Owing to the drought of 1894, that season was not favorable for cereals and small crops. A little irrigation was necessary on portions of the deciduous orchard, as elsewhere reported, but the amount used was very small. The total rainfall for the twelve months from July, 1893, to July, 1894, and for those from July, 1894, to July, 1895, was as follows:

Month.	1893–94.	1894–95.
	Inches.	Inches.
July	.05	.00
August	.00	.00
September	.25	.44
October	1.55	.00
November	1.18	.00
December	4.32	8.18
January	1.44	8.73
February	1.11	1.39
March	.79	3.56
April	.13	.66
May	.36	.00
June	.00	.00
Totals	11.18	22.96

Temperature Notes for 1894 and 1895.—The following table shows the range of temperature at Southern California Station since the last report was issued:

TEMPERATURE REPORT FOR 1894 AND PART OF 1895.—SOUTHERN CALIFORNIA STATION.

Month.	Daily Mean.	Mean Daily Maximum.	Mean Daily Minimum.	Mean Daily Range	Extreme Maximum, and Dates.	Extreme Minimum, and Dates.
1894—January	45.14°	57.19°	32.09°	25.10°	69° 25th, 27th, 28th	26° 6th, 8th
February	46.41	59.42	33.40	26.02	70 27th	28 11th, 17th
March	53.09	65.55	40.57	24.98	80 23d, 28th 29th, 30th, 31st	28 19th
April	63.45	79.33	47.57	31.76	94 19th	38 28th, 29th
May	65.20	78.35	48.20	30.15	92 17th	42 26th
June	64.05	84.04	52.05	21.19	98 6th	48 10th
July	73.30	94.04	58.13	35.91	101 31st	50 7th
August	68.91	96.04	61.35	34.69	110 25th	52 10th, 11th, 13th
September	67.35	88.55	60.15	28.40	100 8th, 10th, 14th	50 27th, 28th
October	60.18	81.25	53.65	27.60	99 4th	46 28th, 30th
November	54.08	77.00	47.50	29.50	90 6th	40 29th
December	48.24	62.64	45.42	17.22	78 27th	34 3d, 21st
1895—January	46.19	61.05	42.03	19.02	72 11th	30 30th
February	49.95	70.91	42.08	28.83	82 27th	32 5th
March	53.17	70.59	44.64	25.95	94 25th	34 16th
April	60.37	70.72	47.33	22.39	88 12th	38 5th
May	65.40	81.60	54.50	27.10	99 10th	43 28th
June	71.50	90.05	52.60	37.45	106 4th	43 2d

THE ORCHARD.

The season of 1894 was the driest known in this district for a long period of years. Although the Station had an abundance of water for irrigation, it was deemed best to cultivate deeply and often, and to use as little water as possible. The pears and cherries, which are on light soil and make less growth proportionately, received one irrigation in June. The young trees, newly planted in the orchard, received three irrigations during the summer.

The orange, lemon, and citron trees received but three irrigations—on April 10th, June 2d, and September 5th. The trees made a continuous and healthy growth through all the summer and fall, and bore a heavy crop of fruit. The first autumn rains came November 5th. The citrus fruit trees showed no sign of drought, with these three light irrigations.

All irrigation was done by allowing the water from the reservoir to run in two furrows, one on each side of the rows, and two feet from the trees.

The citrus and olive orchards were becoming badly infected with black scale (*Lecanium hesperidum*), and they were fumigated with hydrocyanic gas, at an expense of 15 cents per tree. The same treatment was applied to the large date palms, imported by the Agricultural Department at Washington some years ago. The trees thus treated, after eighteen months, show no signs of live scale, and no injurious results from the gas, excepting that on a few of the olive trees the tips of the very young growth were, in some cases, slightly blighted.

Linnets and wild canaries continue to destroy many fruit-buds every winter. They come into the valley from the mountains, and live chiefly on the wild sunflower seed, but are very troublesome to the orchardists. In 1894, the almond and apricot crops were a total failure in outlying orchards, owing to this cause.

Apples.—The following brief notes upon the apple orchard cover all that are yet in bearing. The trees are young, but healthy and well grown.

Skinner's Seedling ripened September 9th, and is a fine eating apple here. There were only a few specimens, and complete tests could not be made.

Missouri Pippin had a heavy crop; of good flavor, but had spots near the core that were clear and translucent (water-core), which may interfere with its keeping qualities; otherwise it is a good winter apple for this section.

Montreal Crab, ripened August 2d; poor for eating, and very small for the variety.

Yellow Siberian Crab was of better quality, and very prolific.

Hyslop Crab is a large, high-colored variety; an excellent jelly apple, and very productive. It is also a very showy apple, and ought to sell well. The best crab apples should certainly be planted more freely in family orchards.

Cherries.—The orchard is not yet old enough to bear, and has had few blooms, and no fruit. In 1894, the trees were irrigated once, at time of bloom. The growth was fair, and all the trees are healthy, except one Early Richmond, which is badly sunburned. The soil does not seem very well adapted to cherry culture, and no great success can be expected with the fruit in this locality. Much better places can be found in the foothills on heavier soil.

Figs.—As far as the growth of the trees is concerned, this is an excellent district; but as the young trees begin to bear, it is evident that many sorts will prove worthless here, by reason of the "fig-sour," which has discouraged so many planters. There is also much trouble about nomenclature. The various collections made by nurserymen and other private persons, and by the Agricultural Department at Washington, contains the same figs, in many cases under several names, and it will take several more years to determine identity. Of the stock received from Washington, at the Southern California Station, the Rubado, Guiglione, Trojano, Black Dattato, White Dattato, and Black Brogiotto are one and the same fig. It is of medium size, and has tender skin, with little rag, and the skin tapers from medium thickness at the stem end, to a very thin skin at the blossom, or open end. The same set of imported figs was received by Mr. Alfred Wright, of Pomona, direct from Washington, and they also proved to be one and the same fig, as above described.

Angelique is a remarkably fine fig here, of very rich flavor; beautiful, light yellow, smooth skin, but of poor color inside. It is a very sweet fig, smaller than White Adriatic.

Monaca Bianca is the best large fig at the Station. The tree is a vigorous grower, and prolific. The fruit is broad in comparison with its length, and of a light green when ripe. It has an exceedingly rough skin; flesh compact and dark red.

Hirtu du Japon and Du Roi were utterly worthless. They soured and rotted on the tree. This illustrates the need of more complete data upon the fig, in different parts of California. At Tulare, Paso Robles, and Amador Stations these two varieties are excellent, and in fact among the leading table sorts.

BEARING FIGS OF 1894.

Variety.	Date When Main Crop Ripened.	Remarks.
Brogiotto		Fruit blighted all the season.
Rubado	September 25th	Poor quality.
Hirtu du Japon	September 29th	Sour and cracked.
Angelique	September 22d	Fine flavor, and smooth.
Monaca Bianca	September 30th	Fine and large, rough skin.
Du Roi	September 2d	Failure; sour.
Smyrna	October 6th	Poor in quality.

Nectarines.—Culture and treatment were the same for peaches and nectarines (see next section). The nectarine is eminently suited to the locality. The table shows results for the past season:

STATISTICS OF NECTARINE ORCHARD.

Variety.	First Flower.	Full Flower.	First Leaf.	Crop Ripe.	Pounds of Fruit.
Red Roman	March 18	March 28	March 27	August 14	25
Early Newington	March 24	March 29	March 29	August 12	30
Elruge	March 14	March 19	March 29	August 15	20
Downton	March 17	March 24	March 24	August 12	20
Stanwick	March 17	March 24	March 23	August 12	30
Victoria	March 27	March 30	March 27	August 28	8
Pitmaston's Orange	March 25	March 31	March 31	August 14	2
River's Orange	March 24	March 30	March 31	August 12	2

The three last named suffered from the birds. Red Roman, Elruge, Stanwick, Downton, and Early Newington were excellent. River's Orange and Pitmaston's Orange, while very sweet, had a slightly bitter taste, which will probably disappear when the trees are older and bear larger crops. Victoria is quite acid.

Peaches.—The importance of the peach orchard at this Station is more and more evident. It already contains a larger number of varieties than have ever before been planted in any one locality in Southern California, and the list is yearly being increased. Among the more recent additions are some of the more valuable seedlings of new Oriental types from the Southern States.

The peach orchard, in both 1894 and 1895, made an excellent showing, and was visited almost daily by fruit-growers from all parts of the county. Several hundred such men tested and compared the different varieties, as they saw them growing side by side, and were given buds of such sorts as they thought most desirable. Opinions necessarily varied greatly respecting the value and quality of many of the newly introduced fruits.

The peach orchard received no irrigation, either in 1894 or in 1895. The trees were heavily pruned, early each winter, and are excellent, typical trees. The fruit, when the size of marbles, was thinned so that one peach was left to about eight inches of branch. The soil was twice plowed, once in the second week of January, at which time a small crop of weeds was turned under. The second plowing was early in March. The orchard was cultivated with a chisel-tooth, two-horse cultivator after each rain and once every month until June, each cultivation being made a little deeper than the preceding one. Four-year-old peach trees, maturing seventy pounds of large peaches to the tree, made an average growth of fully four feet.

The following notes upon the peaches are chiefly from Mr. Mills's manuscript notes, and he has also compiled the useful comparative tables which accompany them. Mr. Mills reports that many visitors; and the newspapers of Pomona, Chino, and Ontario (to all of which the Station is indebted for many kindnesses), have long desired the publication of a separate bulletin upon the Station orchards. These notes of Mr. Mills on peaches are properly the beginnings of such local memoranda.

Taking some of the varieties of peaches for discussion, Mr. Mills says:

Of the early ripe, white, juicy, semi-cling varieties, Amsden's June was the best, being very prolific, of good size, fair color, moderately firm, and would have sold well in the market. It ripened June 20th in 1894, and lasted over two weeks. The tree is a moderate grower.

Waterloo ripened with Amsden's June, but was comparatively worthless.

Alexander ripened June 21st, and was of good quality, but not as highly flavored as Amsden's June.

Briggs' May ripened June 22d, was of fair size, but soft and a poor keeper.

Governor Garland ripened June 24th, and was a little better in quality than any other of its season. The tree is a vigorous grower; fruit fair in size and of a fine color.

Cooledge's Favorite and Large Early York ripened August 5th, and produced large crops of fair and uniform-sized fruit of rich color. As grown at this Station, the two varieties are of about equal value.

Grosse Mignonne and Oldmixon Free, ripe August 7th, and Late Admirable, ripening August 27th, though not extra large, were of excellent flavor and very popular.

Stump the World has been of inferior quality at some other Stations, but seems at home in the Chino Valley.

Ford's Improved was a very soft peach, a poor keeper, and of a bad color, spotted with dusky red, which penetrated to the pit, giving the flesh a streaked appearance. It is of good flavor, however, and was a general favorite among persons testing different varieties for home use. It would not do for market.

These were the more notable white freestones in 1894:

Of the *yellow freestones*, Crawford's Early ripened July 24th, and seemed to maintain its usual market prominence among its class. Though sometimes coarse, and superseded for family use by others, it is still a standard variety.

Foster ripened August 1st, and produced a heavy crop of large, fine-flavored fruit, that astonished the most radical non-irrigationist, as well as those advocating the use of plenty of water. The fruits were extremely large and firm, with perfect pits. It is a good keeper, long retaining its high flavor.

Muir made a poor showing, not over 5 per cent of the fruit being of merchantable size.

Yellow St. John was the finest colored peach in the Station orchard; a deep, rich yellow, almost red, flesh, and a marvelously colored skin. But it seems entirely useless as a market fruit, or even for home use. If picked when firm, it will spoil in a single day; and if gathered when fully ripe, it will spoil in a few hours. Even when eaten directly from the tree, it has a poor flavor. Ripe August 20th, and lasts about four days. This peach appears in many catalogues, and is even highly praised, but it will not do for this district. It is better in Northern California.

Crawford's Late ripened August 23d, and produced a good crop, but is not equal to Crawford's Early, or to Foster in size. The quality is good.

Morris White ripened August 18th, and was the best white freestone in the Station orchard. It is an old, standard peach, still worth extensive planting.

Smock's Late Free ripened September 21st, and was a good market peach, though not highly flavored; fruit was large, round, and firm, but the skin has a poor color; flesh is greenish, and red at the pit. The tree is a good bearer. This is one of the peaches which are hard to classify. It has a very beautiful, light-yellow flesh.

Susquehanna ripened August 18th, and bore a heavy crop of fine, large fruit.

Ward's Late Free was a poor-colored, dry peach. Ripe September 12th.

Comet was the last freestone to ripen, and produced a heavy crop of large fruit. Fruit resembles Smock's Late Free. This is evidently a good late market variety. Ripe October 1st.

Yellow Clings.—Nichols' Orange produced a good crop of fine-flavored fruit, which was fair to medium in size. Ripe August 28th.

California Cling, Seller's Cling, Lemon Cling, Runyon's Orange, and Yellow Tuscany, ripened about August 24th, and gave fine results in every respect, for trees that received no irrigation. The fruit averaged large, some specimens weighing fourteen and fifteen ounces.

McDevitt's Cling ripened August 30th, and produced an extra fine crop of peaches that would average eight ounces; some specimens weighed fifteen ounces.

White Clings.—Heath's Cling made a fine showing; fruit of good size, with an extra fine flavor; ripe, September 10th.

Wilkins' Cling and Staley's California Cling produced well, but gave poor satisfaction in respect to quality.

Chinese Cling was the earliest of the white clings, ripening August 2d; but it was not as good in appearance as Heath's, being red at the pit, making it undesirable for canning.

Salway would apparently have done better with a moderate irrigation.

The Blood Cling is a poor variety, good only for pickling. No large Blood Clings have yet been reported from any part of the State. It is said that in portions of the South, this variety is as large as any cling.

The following table gives the statistics of the peach orchard for 1894:

STATISTICS OF THE PEACH ORCHARD—1894.

Variety.	First Flower.	Full Flower.	First Leaf.	Fruit Ripe.	Pounds of Fruit.
Nichols' Orange	March 13	March 18	March 24	Aug. 28	20
Briggs' Red May	March 19	March 29	March 29	June 22	21
Crawford's Early	March 15	March 18	March 29	July 24	34
Stump the World	March 15	March 20	March 23	Aug. 25	25
Crawford's Late	March 13	March 18	March 22	Aug. 23	26
California	March 13	March 25	March 22	Aug. 24	62
Runyon's Orange	March 13	March 18	March 23	Aug. 25	33
Chinese Cling	March 12	March 18	March 22	Aug. 2	6
Seller's Cling	March 12	March 17	March 23	Aug. 24	29
Amsden's June	March 18	March 24	March 28	June 20	70
Waterloo	March 18	March 29	March 28	June 20	12
Wilkins' Cling	March 15	March 18	March 28	Sept. 23	30
McDevitt	March 18	March 23	March 24	Aug. 30	39
Picquet's Late	March 18	March 23	March 23	Sept. 20	19
Yellow St. John	March 13	March 18	March 28	Aug. 20	32
Smock's Late Free	March 20	March 23	March 27	Sept. 21	40
Mountain Rose	March 17	March 18	March 23	Aug. 9	40
Governor Garland	March 23	March 29	March 29	June 24	65
Heath's Cling	March 13	March 18	March 27	Sept. 10	20
Susquehanna	March 13	March 18	March 25	Aug. 18	40
Henrietta	March 13	March 19	March 24	Sept. 22	30
Lovell	March 13	March 18	March 24	Aug. 28	40
Salway	March 14	March 19	March 24	Sept. 28	30
Grosse Mignonne	March 18	March 24	March 24	Aug. 6	43
Alexander	March 19	March 30	March 30	June 21	35
Oldmixon Free	March 25	March 30	March 26		43
Cooledge's Favorite	March 18	March 25	March 25	Aug. 5	60
Blood	March 18	March 24	March 30	Sept. 1	20
Ward's Late Free	March 17	March 25	March 29	Sept. 12	25
Large Early York	March 13	March 24	March 24	Aug. 5	70
Newhall	March 15	March 18	March 23	Aug. 28	18
Ford's Improved	March 13	March 24	March 25	July 26	26
Morris White	March 15	March 19	March 24	Aug. 18	32
Late Admirable	March 13	March 18	March 25	Aug. 27	30
Oldmixon Cling	March 13	March 18	March 25	Aug. 20	54
Foster	March 13	March 19	March 28	Aug. 1	80
McKevitt's	March 13	March 23	March 24	Aug. 27	16
Staley's California Cling	March 13	March 19	March 23	Sept. 27	33
Muir	March 14	March 25	March 25	Aug. 17	48
Yellow Tuscany	March 19	March 24	March 24	Aug. 31	80
Comet	March 13	March 19	March 29	Oct. 1	60

These forty-one varieties, thus tabulated, represent the older part of the orchard. The peach is so safe here from frost, that the statistics of length of bloom are not essential. The late rains may, in some seasons, injure the blossoms somewhat; but, practically speaking, the peach is secure in this region. The previous notes will guide the planter respecting best varieties.

A very interesting fact, noted in reports from other Stations, is that different varieties of peaches change their order of ripening, more or less, at different seasons. Mr. Mills, in the following table, has compared clingstone peaches—leading varieties—for the seasons of 1894 and 1895, in respect to order of ripening:

COMPARATIVE TABLE OF CLINGSTONE PEACHES.

Order of Ripening in 1894.	Order of Ripening in 1895.
1. Chinese Cling.	1. Chinese Cling (1st in 1894).
2. Oldmixon Cling.	2. Oldmixon Cling (2d in 1894).
3. { California.	3. Runyon's Cling (4th in 1894).
Seller's Cling.	4. California (3d in 1894).
4. Runyon's Cling.	5. { Nichols' Orange (6th in 1894).
5. McKevitt's Cling.	Seller's Cling (3d in 1894).
6. Nichols' Orange.	6. McDevitt's Cling (7th in 1894).
7. McDevitt's Cling.	7. McKevitt's Cling (5th in 1894).
8. Yellow Tuscany.	8. { Wilkins' Cling (12th in 1894).
9. Indian Blood.	Indian Blood (9th in 1894).
10. Heath's Cling.	9. Yellow Tuscany (8th in 1894).
11. Henrietta.	10. Staley's California (13th in 1894).
12. Wilkins' Cling.	11. Henrietta (11th in 1894).
13. Staley's California.	12. Heath's Cling (10th in 1894).

These variations work both ways. Wilkins' Cling was earlier in 1895 than in 1894, but Seller's and Heath's were later. The following table shows the comparative ripening seasons of the freestones:

COMPARATIVE TABLE OF FREESTONE PEACHES.

Order of Ripening in 1894.	Order of Ripening in 1895.
1. { Amsden's June.	1. Governor Garland (4th in 1894).
Waterloo.	2. Briggs' Red May (3d in 1894).
2. Alexander.	3. { Amsden's June (1st in 1894).
3. Briggs' Red May.	Alexander (2d in 1894).
4. Governor Garland.	4. Waterloo (1st in 1894).
5. Crawford's Early.	5. Ford's Improved (6th in 1894).
6. Ford's Improved.	6. Mountain Rose (10th in 1894).
7. Foster.	7. Large Early York (8th in 1894).
8. { Large Early York.	8. Yellow St. John (13th in 1894).
Cooledge's Favorite.	9. Cooledge's Favorite (8th in 1894).
9. Grosse Mignonne.	10. { Crawford's Early (5th in 1894).
10. Mountain Rose.	Grosse Mignonne (9th in 1894).
11. { Muir.	Foster (7th in 1894).
Susquehanna.	11. Morris White (12th in 1894).
12. Morris White.	12. { Muir (11th in 1894).
13. Yellow St. John.	Susquehanna (11th in 1894).
14. Crawford's Late.	13. { Crawford's Late (14th in 1894).
15. Stump the World.	Newhall (17th in 1894).
16. Late Admirable.	14. Stump the World (15th in 1894).
17. { Lovell.	15. Lovell (17th in 1894).
Newhall.	16. Late Admirable (16th in 1894).
18. Ward's Late Free.	17. Smock's Late Free (20th in 1894).
19. Picquet's Late.	18. Picquet's Late (19th in 1894).
20. Smock's Late Free.	19. Ward's Late Free (18th in 1894).
21. Salway.	20. { Salway (21st in 1894).
22. Comet.	Comet (22d in 1894).

Here are more minute variations than for the clings, and more in number. The rise of Governor Garland, Mountain Rose, Yellow St. John, and some others, in the column for 1895 (as compared with that of 1894), and the sinking of Waterloo, Crawford's Early, Foster, and others, while Late Admirable remains the same, can only be attributed to minute climatic differences in the two seasons, which favored one variety more or less, as the case might be. Such variations justify an orchardist in planting a full range of varieties. Of the earliest type, for instance, three or four kinds would seem desirable.

In 1895, the peach orchard again yielded an excellent crop. The following table gives the statistics:

STATISTICS OF PEACH ORCHARD FOR 1895.

Variety.	First Flower.	Full Flower.	First Leaf.	Full Leaf.	Ripe.
Governor Garland	March 4	April 1	March 29	April 15	June 15
Briggs' Red May	March 4	March 24	March 7	April 15	June 16
Amsden's June	March 8	March 25	March 19	April 15	June 17
Alexander	March 17	March 31	March 28	April 15	June 17
Waterloo	March 8	March 18	March 18	April 15	June 19
Ford's Improved	March 2	March 16	March 18	April 15	July 11
Mountain Rose	March 1	March 14	March 17	April 15	July 12
Large Early York	March 4	March 18	March 4	April 15	July 15
Yellow St. John	March 4	March 12	March 7	April 15	July 17
Cooledge's Favorite	March 5	March 15	March 8	April 15	July 20
Crawford's Early	March 2	March 15	March 10	April 15	July 21
Grosse Mignonne	March 7	March 16	March 7	April 15	July 21
Foster	March 4	March 15	March 6	April 15	July 21
Oldmixon Free	March 7	March 18	March 8	April 15	July 25
Morris White	March 4	March 15	March 7	April 15	Aug. 3
Muir	March 8	March 23	March 8	April 15	Aug. 5
Susquehanna	March 4	March 14	March 6	April 15	Aug. 5
Crawford's Late	March 2	March 14	March 15	April 15	Aug. 8
Newhall	March 4	March 14	March 5	April 15	Aug. 8
Stump the World	March 2	March 16	March 14	April 15	Aug. 12
Lovell	Feb. 28	March 9	March 4	April 15	Aug. 13
Late Admirable	March 8	March 24	March 22	April 15	Aug. 17
Smock's Late Free	March 4	March 18	March 12	April 15	Aug. 28
Picquet's Late	March 5	March 18	March 8	April 15	Sept. 1
Ward's Late Free	March 8	March 28	March 27	April 15	Sept. 10
Salway	March 7	March 9	March 8	April 15	Sept. 18
Comet	March 13	March 20	March 14	April 15	Sept. 18
Chinese Cling	March 5	March 16	March 7	April 15	Aug. 1
Oldmixon Cling	March 4	March 14	March 4	April 15	Aug. 5
Runyon's Orange Cling	March 2	March 14	March 5	April 15	Aug. 8
California Cling	March 2	March 16	March 6	April 15	Aug. 12
Nichols' Orange Cling	March 4	March 14	March 7	April 15	Aug. 14
Seller's Cling	March 2	March 14	March 5	April 15	Aug. 14
McDevitt's Cling	March 2	March 18	March 12	April 15	Aug. 16
McKevitt's Cling	March 2	March 19	March 9	April 15	Aug. 19
Wilkins' Cling	March 3	March 14	March 4	April 15	Aug. 20
Indian Blood	March 5	March 25	March 19	April 15	Aug. 20
Yellow Tuscany Cling	March 5	March 19	March 8	April 15	Aug. 21
Lemon Cling	March 14	April 1	March 24	April 15	Aug. 21
Staley's California	March 2	March 15	March 7	April 15	Sept. 6
Henrietta	March 6	March 15	March 17	April 15	Sept. 15
Heath's Cling	March 7	March 14	March 16	April 15	Sept. 15

Mr. Mills, in 1895, determined the comparative weights of pits and flesh in a number of leading varieties. The following table gives this data, and includes notes upon curl leaf, which was worse in 1895 than in 1894:

STATISTICS OF PEACHES—1895.

(Weight of fruit from two trees of each kind; weight of five peaches; percentage of pit to whole fruit, and amount of curl leaf.)

Variety.	Crop, in Pounds.	Weight of Five Peaches, in Ounces.	Per Cent of Pit.	Curl Leaf.
Large Early York	88	16½	4.4	Medium.
Yellow St. John	45	13⅓	4.0	Bad (early).
Cooledge's Favorite	89	19¾	3.5	Medium.
Crawford's Early	97	$21\frac{8}{9}$	3.8	Slight.
Grosse Mignonne	103	20⅓	3.4	Slight.
Foster	128	$25\frac{8}{9}$	3.8	Slight.
Oldmixon Free	81	23⅓	3.1	Medium.
Morris White	100	24½	2.8	Medium.
Muir	55	22	3.5	None.
Susquehanna	40	$27\frac{2}{9}$	3.2	Medium.
Crawford's Late	75	28¾	3.5	Medium.
Newhall	41	34¾	3.0	Slight.
Stump the World	42	24¾	3.0	Medium.
Chinese Cling	10	22½	4.1	Bad.
Oldmixon Cling	55	21	4.0	Bad.
Runyon's Orange Cling	65	41½	2.9	Slight.
California Cling	90	34	3.4	Slight.
Nichols' Orange Cling	106	35	3.8	Slight.
Seller's Cling	68	40	3.6	Slight.
McDevitt's Cling	60	37½	3.2	Medium.
McKevitt's Cling	63	35	2.9	Slight.
Yellow Tuscany Cling	162	47½	2.9	None.

All the early peaches of the Briggs' May type showed a trace of curl leaf. Lovell had no crop, showing rust and curl leaf. Ford's Improved, Wilkins' Cling, and Picquet's Late were also bad. Ward's, Salway, and Henrietta suffered from curl leaf.

In the above table, the proportion of pit to peach is small. Station Bulletin No. 97, "Investigation of California Prunes, Apricots, Peaches, etc.," by Mr. George Colby, gives the following results: Orange Cling, grown at Anderson, Shasta County, number per pound, 3.1; pits, 6.1 per cent of total weight; Lemon Cling, grown at Chico, Butte County, number per pound, 2.2; pits, 6.3 per cent of total weight. These peaches were shipped some distance, and had necessarily lost some weight before they reached the laboratory of the Agricultural Department. Nevertheless, the comparative lightness of the Southern California pits is worth notice. Compare, in the preceding table, Nichols' Orange and Seller's with Orange and Lemon Clings in the University bulletin just quoted. The advantage on the side of the Station peaches is notable. Even the pit of the Chinese Cling, belonging to a different type (and possessing an unusually heavy pit), weighs but 4.1 per cent of the total fruit weight, while Runyon's Orange Cling has a pit which weighs but 2.9 per cent of its total weight. The average of the nine varieties of clings tested in this particular at the Station shows a weight of pit which is not appreciably greater than half the weight of the Lemon Cling noted in Bulletin No. 97. (See table facing page 96, Report of Work of the Agricultural Experiment Stations for 1891-92.)

Pears.—The orchard is young, and little fruit can yet be expected. Last season, there were but two varieties that matured fruit, though several others would have, had it not been for the crows, which even ate

Beurré Clairgeau pears when hard and green. None of the trees had over half a dozen pears apiece.

Howell had a few fine-looking pears, but it is a poor keeper, soon getting soft at the core.

Duchesse de Mouchy ripened about the middle of November—a large, coarse-grained, ill-shaped fruit, of a brilliant red on one side, but not highly flavored. This is one of the newer French pears of Elwanger and Barry's importation.

Plums.—The plum orchard was not irrigated, either in 1894 or in 1895, but some trees made a growth of four or five feet each season. The trees held their leaves very late, and all were healthy. There was but 1.12 inches of rain between the last of January, 1894, and the middle of October following. The leaves of a few trees were destroyed by a small brown beetle (*Serica fimbriata*), but these trees afterwards put out a new growth of foliage.

Of the Japanese varieties, Botan seemed to be the favorite. It yielded about fifteen pounds of large, finely flavored fruit, of a dull yellow color, heart-shaped. The fruit was about an inch and three quarters in diameter. Ripe August 1st.

Botankio ripened July 25th. Yield of tree, twelve pounds.

Masu ripened August 17th; yield was but a half dozen plums.

Burbank ripened July 18th, producing about fifteen pounds of finely colored fruit, with good flavor and fine keeping qualities.

Kelsey ripened September 1st, producing twenty-five pounds of fruit; good flavor, fair size, but poor in color. This variety varies much in this respect, according to district and season.

The following table gives the statistics of the foregoing plums:

Statistics of Japanese Plums.

Variety.	First Flower.	Full Flower.	First Leaf.	Ripe.	Crop, in Pounds.
Botankio	March 15	March 25	March 25	July 25	12
Burbank	March 16	March 24	March 23	July 18	15
Satsuma	March 12	March 19	March 16	No crop	
Masu	March 14	March 20	March 15	Aug. 7	1
Kelsey	March 12	March 19	March 16	Sept. 1	25
Botan	March 23	March 30	March 28	Aug. 1	15

The flower buds of the plums and prunes all suffered greatly from the ravages of linnets and wild canaries.

Oranges.—There was very little fruit in the citrus orchard in 1894, but it was all of good size. The early varieties began to ripen December 15th. The following table gives the orange statistics for 1894:

ORANGE CROP, SEASON OF 1894–95.

Variety.	First Flower.	First New Leaf.	Fruit Colored.	Yield per Tree—Number of Oranges.
Washington Navel	April 19	March 14	Nov. 10, 1894	1 to 8 doz. (diff. trees).
Pineapple	April 20	March 14	Dec. 10, 1894	2 to 12 doz. (diff. trees).
Ruby	April 24	March 14	Dec. 10, 1894	2 to 7 doz. (diff. trees).
King	April 24	March 16	Dec. 10, 1894	2 to 4 doz. (diff. trees).
Tangerine	April 25	March 10	Nov. 15, 1894	3 to 6 doz. (diff. trees).
Jaffa	April 24	March 16	Dec. 10, 1894	1 doz.
Homosassa	April 26	March 15	Nov. 15, 1894	3 to 8 doz. (diff. trees).
Malta Blood	May 3	March 15	Jan. 5, 1895	3 doz.
Mediterranean Sweet	May 3	March 15	Jan. 1, 1895	3 to 5 doz. (diff. trees).
Hart's Tardive	May 1	March 15	Dec. 25, 1894	3 doz.
Magnum Bonum	April 26	March 15	Dec. 15, 1894	2 to 5 doz. (diff. trees).
Parson Brown	April 26	March 14	Dec. 15, 1894	1 to ½ doz. (diff. trees).

Tangerine and Washington Navel were fully eatable on January 15, 1895. The poorest variety was Jaffa; the fruit cracked and was not well flavored.

The only lemon coming into bearing before the close of 1894, was Villa Franca. The trees bore only about a dozen fruits. During the summer of 1895, the Eureka and Genoa as well as Villa Franca began to yield lemons, but the report proper belongs to the season of 1895–96.

Other Fruits.—Loquats bore no crop in the spring of 1895, the blossoms being destroyed by the frost of January 30th (30°). The older pomegranate trees bore fair crops in 1894, and again in 1895. Spanish Ruby was most satisfactory, and was as sour as a lemon.

THE VINEYARD.

While the detailed reports upon the grapes from each and all of the outlying stations properly belong to the Viticultural Department, it is proper to note here the condition of the vineyards. At the Southern California Station, while a large and interesting collection of wine and table grapes has been planted, and will be of much service to growers, the soil is not altogether adapted to the vine. There are few vineyards in the district, except some of Muscat for raisin grapes, and these are being removed to make place for orchards.

OLIVES.

Mr. Mills's interesting notes upon the pollination of olive blossoms will be found elsewhere in this report. The different varieties receive such ample attention in Mr. Hayne's report already published (Investigations of California Olives and Olive Oils, in Report for 1893–94, page 279), as to render detailed notes unnecessary here. The olive orchard has made excellent growth, and is in all respects successful and a credit to the Station.

DATE PALMS.

In previous reports will be found an account of the named varieties of date palms received from the Department of Agriculture (Experiment Station Report for 1890, pp. 221–223; also, Experiment Station Report for 1891–92, pp. 144–147).

Eleven date trees were sent to Pomona, as follows: One male tree, for fertilization of all; and one tree of each of the following varieties: Fard, Amhat, Nakleh-el-Pasha, Seewah, Hazaneh, Zeb-el-Abed, Sultaneh, Amreeyeh, Rasheedeh.

The Fard tree was missent, and remained so long without being delivered that it was dead when it reached the Station. All the others have grown. They exhibit a surprising range as respects hardiness and character of growth, as the following notes will sufficiently show:

In 1894 (February 28th) the largest palms were measured by Mr. Mills, the foreman.

Seewah was six feet high, and six feet across; in fine condition, not hurt by frost; eight offshoots.

Amhat was slightly frosted during that month; five feet high; two offshoots.

Sultaneh, badly frosted, though protected by covering of straw; four feet high; one offshoot.

Zeb-el-Abed, only slightly frosted; five feet high; four offshoots.

Rasheedeh, four feet high; no offshoots; plant slightly frosted.

The male plant was frosted in the center; four feet high; no offshoots. Plant badly injured, though protected by straw.

The severe frosts of the spring of 1894 were from the 5th to the 10th of January, inclusive, when the thermometer ranged from 28° to 24°. As noted above, Sultaneh and the male date suffered badly. Sultaneh had the appearance of being damaged more by frost than any other variety, but it recovered rapidly during 1894, and has been making a fair growth. It is now (December, 1895) four and a half feet high, with a spread of six feet of leaves; the circumference at the base is two feet. The foliage of this palm is a pure, rich green, and very ornamental. The palm being so sensitive to cold, and of such slow growth, will not be much planted for ornament, as *P. canariensis* is just as handsome and is not affected by the cold. Unless the Sultaneh bears fruit of a superior quality, it may as well be considered a failure in this district, and dropped from the list.

Rasheedeh and Hazaneh have been apparently uninjured by frost, but are very slow growers. The former is now five and a half feet high, with eight feet spread of leaves, and a base circumference of three feet. The latter is six and a half feet high, six feet across, and four feet in circumference at the base. The foliage is coarse, and of a greenish-lead color.

Amhat has the same appearance as the last two named, but has made a much better growth. It is seven and a half feet high, ten feet across, with a girth of three and a third feet.

Nakleh-el-Pasha has the same appearance as the preceding variety in condition and growth. It is now five feet high, eight feet across, and three and a half feet in circumference at base.

Zeb-el-Abed is a promising variety as far as growth is concerned. It has for its height a larger circumference in leaves than any other, indicating a heavy, strong trunk. It is eight feet high, and eleven feet across; the circumference at base is four feet.

Seewah is the strongest and thriftiest grower of the lot. It continues to grow during the whole year, and has never shown any sign of injury from frost. It is very ornamental. It is now ten feet high and ten feet across, with a base circumference of six feet.

The male date has not recovered from the effects of the freeze. It is in a very poor condition, the leaves being stunted and deformed. The lateral leaflets are but four inches long, while the normal growth should be fully ten inches. It is sending out suckers, and the variety can be saved in case the original plant dies. All the varieties are forming offshoots.

The waste water from a leaky pipe ran on the palms for ten days, at two different times during the summer of 1895, under which conditions the trees made a rapid growth. There was a flow of water which made, for the twenty days, about 57,800 gallons, by measurement. None of the water ran to waste, all of it soaking into the ground, which, at this corner of the Station tract, is very sandy and gravelly—the poorest portion of the whole thirty acres.

Reviewing the above, it is worth noting that the male plant at Tulare City seems of hardier stock than the one at Pomona, enduring, without injury, greater cold; at Tulare, also, the Seewah variety makes the strongest growth of all the palms there, and bids fair to be an acquisition of extreme importance to the warmer parts of the State.

BERRIES.

Strawberries.—The heaviest soil at the Station, a red, sandy loam, proved to be an excellent one for strawberries. With a mulching of well-rotted stable manure, and irrigation about every ten days, they gave an abundant yield. The following eighteen varieties were tested at the Station: Longworth, Felton, Sharpless, Jersey Queen, Lovett, Monarch, Parker Earle, Jessie, Wilson's Albany, Eureka, Captain Jack, Giant Prolific, Parry, Schuster's Gem, Australian Crimson, Number 2, Shuckless, and Oregon Everbearing.

Wilson's Albany and Sharpless maintained their well-known reputation.

Parry produced a good crop throughout the summer, and a few late in the fall; fine color and flavor.

Captain Jack is a good berry here; fine color, and almost as good as Parry.

Giant Prolific is a berry of only medium value at this Station. The fruit, when shaded, is white and tasteless.

Longworth is an excellent berry, and a continuous bearer.

Monarch is a good berry, and of fine color.

Jersey Queen and Eureka are both very poor, being ill-shapen, and lacking in flavor.

Jessie did poorly during the first of the season, but later did better, though not so well as many other varieties.

Schuster's Gem did well, but did not bear as heavily as Wilson's Albany, Captain Jack, Parry, Parker Earle, and Lovett.

Blackberries.—The following blackberries have been planted, and are just beginning to bear fruit: Oregon Evergreen, California Evergreen, Erie, Crandall, Child's Tree Blackberry, Rochelle's New Blackberry, Lucretia Dewberry.

Hybrid Berries.—The Logan berry has been an entire success, and attracted much attention for two seasons past. Several hundred plants were rooted from the tips, and distributed in the spring of 1895. A hybrid dewberry gives much promise of being desirable. Several other hybrids of *Rubus ursinus*, and varieties of the common raspberry, have been obtained for trial here.

SMALL CULTURES.

The square-pod pea (*Lotos tetragonolobus*), planted late in May, 1894, on receipt of seed, and irrigated, made only a stunted growth, and perfected but few seeds. *Trifolium incarnatum* did better, but never grew rapidly, though it matured an abundance of seed.

The best sweet potatoes grown in 1894 were California, New Jersey, and Southern Queen. The foreman reports that the white-fleshed varieties do best on alkali soils, while the yellow-fleshed varieties do best on sandy soils, free from alkali.

The onion crop suffered from drought in the spring of 1894. Neapolitan Maggiazola, sent to the Station for trial by Burpee & Co., was the best and earliest variety.

Giant Paschal and Crawford's half-dwarf celeries were planted along the overflow from the reservoir. The former was much the better variety.

The crows did a good deal of damage in the vegetable garden, but they were very effective in eating the dangerous beetles (*Serica fimbriata*), which were destroying the leaves of the pepper trees, geraniums, acacias, pomegranates, plums, and many other flowering plants and trees. It would therefore have been poor policy to shoot or poison them.

THE TEN-ACRE TRACT.

The work done on the ten-acre tract, since Mr. Mills took charge of the Station, has been very successful; opening up new lines of investigation, which promise to occupy the department and foreman for a long time to come.

The gradual reclamation of this ten-acre tract of moist land and its utilization for various crops and experiments, can be traced through preceding Reports (Agricultural Experiment Station Report for 1890, pages 37, 38, and 292; Report for 1891–92, pages 117 and 212; Report for 1892–93, and part of 1894, page 420). The important soil studies and analyses of beets grown on this tract, together with charts, appear in another part of this Report (page 71).

Grasses.—In the winter of 1893–94, after the ten-acre tract had been thoroughly well broken, the following grasses were sown upon nearly three acres of surface: Hungarian Brome Grass (*Panicum Germanicum*), Mesquite, or Velvet Grass (*Holcus lanatus*), Red Top (*Agrostis vulgaris*), Perennial Rye Grass (*Lolium perenne*), Timothy (*Phleum pratense*), Tall Oat Grass (*Avena elatior*). It was hoped that they might give a permanent stand, showing the adaptability of these moist lands to grass crops; but the alkali in the soil rose faster than was expected, and the plantation proved, a failure. Besides the larger plots of the grasses named, twenty-eight other varieties, comprising the best known and most desirable species for moist lands, were sown in small plots, and none succeeded even fairly well. A few were marked for further trial when the tract has been more nearly reclaimed.

Early in May, 1894, the failure of these grasses became obvious. The foreman wrote: "The season has been so dry that the alkali has accumulated on the surface to such an extent that it has almost entirely killed out all the grasses. I sowed Nepaul and beardless barley, and had a good stand, but it is turning yellow, and large spots of it have died. It is not too late to plant beets."

Cereals.—Of corresponding tenor was the result of trials made in 1894 with the leading species and varieties of cereals, which were planted in small culture plots in the usual manner.

The following *Wheats* were planted: Volo, Hackett's Australian, Greek Atlanti, Carter's Hundredfold, Carter's Anglo-Canadian, Carter's Pride of Market, Carter's Prince of Wales, Carter's Birdproof, Carter's Earliest of All, Carter's Flourball, Carter's Queen, Carter's Miller's Delight, Carter's Pearl, Petali, Missoyen, Russian Red-bearded, Hessian Flyproof, Holborn Wonder, and Stand Up. It was impossible to make a fair comparison of these varieties, as the small amount of space used was so badly spotted with alkali. In some places the grain was almost dead, while a few feet away it did fairly well. Hackett's Australian was almost worthless on account of smut.

The following varieties of *Oats* were planted: Scotch Hopeton, White Bolognese, White Flanders, White Australian, Black from Calumiers, Hallett's Pedigree, White Canadian, Hallett's Pedigree, Tartar, Ligovo, Surprise, and Welcome. The oats did better than the wheat.

The *Barleys* planted were Two-rowed, Berkeley Hybrid, Six-rowed, Export, Chevalier, Two-rowed Spring, Carter's Prolific, Italia, Scotch Annate, Earliest Black Two-rowed, Black Six-rowed, and Peacock. The barley stood alkali rather better than did the oats.

The *Ryes* were Excelsior, Swedish, Perennial, and Hungarian. The rye was no better than the oats.

Sunn hemp (*Crotalaria juncea*) was a failure, and was so reported to the Department at Washington, giving conditions under which it was experimented with.

Hairy vetch and Wonderful cow pea did extremely well in some places, while in others they were a total failure.

Orchard.—It was decided to test the fitness of this land for certain fruit trees. The experiments, elsewhere noted, having shown some of the peculiarities of the composition of alkali and its adaptation to beet culture, there was a possibility that some kinds of fruit would thrive. A selection of some ninety varieties of pears, apples, and plums (on Myrobalan stock) was planted in the spring of 1895, and so far the young orchard has done very well, indeed. A few nut-bearing and moisture-loving trees have been set, and the collection will be increased as opportunity offers.

Sugar Beet Crops.—When the grasses failed in the spring of 1894, the attention of the foreman was at once directed to sugar beets, and he planted the unoccupied part of the tract in beets, making successive plantings, and treating the field on a purely experimental basis. The beets from this field (four acres) sold at the Chino Beet Sugar Factory for $226 30, and the expenses of the crop were $83 66, leaving a balance of $142 64. In 1895, it was again of the utmost importance to continue experiments with beet culture, and separate plantings were made, at regular intervals, using seed from different sources. The surplus beets sold at the factory for $375 75, and the expenses of handling the crop were $190 85, leaving a balance of $185 26. Thus, in 1894, there was a profit to the Station of $142 64, while conducting important experiments, and in 1895, a profit of $185 26, making a total of $327 90. This sum was turned over to the Secretary of the Board of Regents, and by order of the Regents, placed in a special fund for the use of the Experiment Station.

THE OLIVE IN CHINO VALLEY—POLLINATION EXPERIMENTS.

By J. W. Mills, Foreman Southern California Experiment Station.

In 1888, Rev. Mr. C. F. Loop, of Pomona, imported into California, from J. Audibert, Director of Hanyer's Experiment Station, France, the following varieties of olives for oil: Rubra, Atroviolacea, Uvaria, Oblonga, Picholine; also, for pickles, Regalis and Hispania.

In 1889, Mr. Loop imported from Mr. Ralfeleo Pecori, in the City of Florence, Italy, the following varieties of olives for oil: Razzo, Grossajo, Rossellino, Belmonte, Olivastro, Leccino, Piangente, Morinello, Correggiolo, and Infrantojo; also, varieties for pickling, Santa Caterina, San Agostino, and Ascolano, the white olive of Ascoli.

Razzo, Piangente, Rubra, and Oblonga have proven to be exceedingly prolific.

Santa Caterina, Picholine, Ascolano, and Hispania are promising olives. They have a white pulp, and are among the best olives for pickling. The Picholine mentioned is the true Picholine. It has fruited here and proves to be what the name denotes in Europe.

Belmonte comes into bearing early, but as yet does not seem to be prolific. It is very sensitive to wind.

Correggiolo and Pendoulier oil is used abroad in the manufacture of perfumery, because it has no decided flavor or odor.

The olive department of the nursery business has developed to large proportions in the Chino Valley, fully 500,000 trees being propagated annually. The herbaceous method is being used exclusively. There is a great difference in the rooting capacity of olives by this method. The Nevadillo Blanco, for instance, will root almost as easily as a willow-cutting, while the Rubra and Hispania are very difficult to root. As a result of this, a larger number of Nevadillo Blanco olives have been planted than of any other variety. It is falling into disfavor in some localities, on account of its not being an early bearer and also because of its inferiority as a pickling olive. Its bearing qualities can, no doubt, be improved by planting other varieties with it. Severe pruning will, perhaps, induce it to bear earlier, as it is a rank grower and makes a large amount of wood.

From experiments carried on in different localities in the Chino Valley, and at the Southern California Experiment Station, it is now a well-established fact that most varieties of olives bear better when two or more varieties are planted in close proximity. It is the experience of two years that the Mission olive bears heavy crops when planted near to Rubra trees. Each variety seems to be benefited by the influence of the other. The Rubra is a very large bearer, and is a good variety to graft or bud into alternate rows of trees in Mission olive orchards.

Experiments were carried on at this Station, during the past year, to see which varieties would fertilize themselves, and which were benefited by cross-fertilization. Paper bags were placed over a large number of olive branches that were full of blossom buds, the mouth of each bag being tied tightly around the limb to keep out insects. Rubra and Præcox proved to be absolutely infertile. These two varieties are claimed by some olive-growers to be identical, and the fact that they are both infertile makes it possible, if not probable, that they are the same olive. These varieties were heavily laden where the limbs were exposed, and the cross-pollination was thus left to natural causes—wind, insects, etc.

Atroviolacea was almost infertile; the few berries that matured from self-pollinized flowers were smaller than where the insects and wind had free access.

Salonica was infertile, all of the inclosed flowers producing only beads (olives no larger than a grain of wheat, when grown). Ten per cent of the flowers on the open tree produced beads.

Oblonga was fairly fertile; the tree is a prodigious bearer, and the fruit is about the average size.

Manzanillo, Columbella, Regalis (nomenclature of this tree not positively determined), Macrocarpa, Lucques, and Polymorpha fertilized themselves perfectly. These are large olives, the first three being about average size, and the last three extremely large.

Atrorubens and Mission were almost infertile, dropping all the flowers and flower-stalks inclosed in the paper bags.

Pendulina was infertile, but the protected flowers produced beads, and fully 95 per cent of the unprotected flowers did the same.

Verdale had the same fault as Pendulina, with the exception that a few of the confined flowers produced dwarfed olives; 80 per cent of the exposed flowers produced beads.

Huff's Spanish was absolutely infertile, every one of the confined flowers producing beads, while there was not an exposed flower which did not produce a perfect olive, or fall from the stem—not a bead was found outside of the paper bags.

All of the smaller varieties, without exception, failed to fertilize their own flowers when confined in the paper bags; some of the medium-sized varieties of olives fertilized their own flowers perfectly, others imperfectly, and some of them not at all. All of the large-sized olives experimented with, fertilized their own flowers perfectly.

The conclusion arrived at would seem to be that the higher bred, or larger, olives produced pollen having greater vitality than that of the smaller ones. This is the result of only one year's experience. A long series of experiments might greatly change or modify this conclusion.

The same line of work is being continued, with such slight variation as experience renders advisable.

E. THE FORESTRY STATIONS.

WORK OF THE STATIONS AT SANTA MONICA AND CHICO.

By CHARLES H. SHINN, Inspector of Stations.

This report, continuing the brief historical sketch contained in the last published volume, gives an account of work done during the calendar year of 1894 and the first half of 1895, closing the period for which the State Legislature of March 3, 1893, appropriated $4,000 to carry on these stations. The terms of that Act, abolishing the late Board of Forestry, and turning over the State property in its possession to the University of California, distinctly imply the recognition, by the State, of the duty to maintain them by continued and reasonable appropriations. In accordance with this principle, the last Legislature appropriated the sum of $5,000 to maintain the stations for the two fiscal years ending June 30, 1897. While this sum of $2,500 per annum is insufficient to develop, on a commensurate scale, the educational and illustrative work desirable in California forestry, it is nevertheless enough to enable the stations to be kept up in a modest manner, and to enlarge their scale of usefulness. It will be wise public policy for further legislation to somewhat increase the resources of these stations, which are admirably located for experimental work in forestry.

The late Forestry Commission, according to their printed financial reports, spent $33,493 33 upon the two stations at Chico and Santa Monica, in 54½ successive months. This was at the rate of $7,400 a year, and does not include many expenses of the central office of the late Commission, which properly belonged to and served to aid the local stations. Nevertheless, after this large expenditure of over $33,000, there were neither buildings, horses, farm tools, wagons, nor scientific apparatus at Chico Station; and although there were some buildings at Santa Monica, and a pair of neglected horses, there were few tools, no wagons, and no scientific apparatus. At neither station were there any thermometers, hygrometers, or other instruments for weather observation. There were no record books or nursery books, nor memoranda of the history of the stations, or of the various plantations, or of the single trees. If the stations had been equipped even remotely as well as an ordinary twenty-acre farm, a thousand dollars of the legislative appropriation of 1893, that was necessarily spent for horses, tools, and outfit, could have been used for additions to the arboretums. The wretched condition of the two stations at the time the University took charge is matter of public notoriety.

The wise and economical expenditure of the Forestry Station appropriations, which has prevailed during the past two years, is fully recognized by the State officials and those whose duties give them personal knowledge of the facts. But it is equally necessary that the general public should understand, as far as possible, the financial side of forestry work. Obtaining possession of the forestry stations in July, 1893, in an unequipped and broken-down condition, as more fully explained in my previous report, we paid out $2,902 06 during the fiscal year 1893–94, buying horses, plows, harrows, cultivators, and other tools; clearing brush and destroying weeds; painting the buildings at Santa Monica; making a barbed-wire fence along the bluff, to keep cattle from destroying trees; and, in brief, putting the Santa Monica Station in proper condition for experimental work. We paid for horses and horse feed about $300; necessary tools cost about $250; lumber, drain-tiles, paint, nails, glass for propagating sashes, were among the items of the first year's expenditure. One of our foremen receives $50 per month, with a cottage, rent free, and firewood, but no perquisites of any other kind; the other foreman receives $60, without a cottage, and without firewood. Both foremen are expected to work with the laborers, and to carry on the stations with as much economy as possible. The pay of the two foremen, $1,320 per annum, represents, therefore, not only local supervision and experimentation, but also a very considerable amount of physical labor. It is proper to explain, however, that, as a rule, only men of average skill and intelligence in nursery and arboretum work can be obtained for such salaries. Occasionally, a young man of especial fitness may be procured, temporarily, by reason of his love for the work; but it is in every way desirable that some way may be found to increase these salaries to $75 per month, the sum paid each of the farm foremen at the four sub-stations. As matters are now, we pay, for the salaries of the foremen, $1,320 per annum, which is all that business principles and a wise prudence justify. Of the State appropriation of $2,500 per annum, there is, therefore, only $1,180 remaining to cover all the year's expenses of additional labor, of new trees and seeds, of supplies, of blacksmith bills, of postage, stationery, freight, expressage, traveling expenses, tools, implements and machinery, chemicals, and whatever else becomes necessary in carrying on two stations of twenty and twenty-nine acres, respectively, situated some four hundred miles apart. In every direction it has been necessary to practice the most rigid economy, and to adopt every means available to reduce expenses.

Under the late Forestry Commission, the stations did not produce any hay, although the larger part of each tract lay waste. By clearing these lands, the foremen were enabled to grow most of the supply of hay needed last year and all this year, at merely the outlay for seed, the cost of mowing the crop, and the expense (a permanent investment) of building cheap hay-sheds. By fertilizing the soil, the area required to produce hay will be reduced to the minimum, and as tree-planting requires all the land, it is probable that outside tracts can be rented cheaply. In the case of the forestry stations, as with the farm stations, we have been able to produce larger crops of hay at less outlay, than that of the average farmer, materially reducing the cost of running the stations, and thus securing a greater part of the limited appropriation for purely forestry uses. In all, during 1893–94 and a part of 1894–95, we grubbed and cleared about twelve acres at Santa Monica, and six acres at Chico—land which had never been broken. This work, and also the difficult contest with Johnson grass at Chico Station, is more fully noted in the separate Station reports.

Views of Others.—The Executive Committee of the American Forestry Association says, in a recent review of forestry affairs in the United

States: "In California the management of the forestry stations established by the first Forest Commission has fallen into the competent hands of the University of California, and the signs are hopeful of a successful revival in the organization of the forestry interests of the State."

Professor B. F. Fernow, Chief of the Forestry Division of the Agricultural Department at Washington, wrote, under date of October 31, 1894:

Charles H. Shinn, *Inspector of Forestry Stations, Berkeley, Cal.:*

Dear Sir: I have read your report on forestry stations for California with interest and satisfaction, as it shows that the wreckage of the forestry movement in your State, which started out under such promising auspices and was run into the ground so pitiably, has fallen into capable hands and rational management. There can, it seems to me, hardly be any doubt among thinking statesmen that the maintenance of such nuclei of forestry interests as is afforded by the stations, at so small an expense, is not only legitimate and practical for the present, but bids fair to work out unquestionable benefits for the future of the State. For, sooner or later, the problems with regard to forest-cover and its relation to agricultural success, will present themselves with the same urgency in California as they have presented themselves in other countries and other States. To have, in time, laid a foundation for a smoother solution of the same will then be considered an act of wise statesmanship.

While I cannot at all agree that the maintenance of such stations exhausts the possibilities of legitimate preparation for the future, they can certainly serve various good objects. Among these, they would serve in making your people conversant not only with the adaptation of exotic trees of commercial value to your climatic conditions, but also with what may be expected from your native trees, with proper treatment: they will give opportunity for developing such methods of culture as will yield the best results; in short, as many problems can be solved at these stations in regard to treatment of wood crops, as present themselves to agricultural stations with reference to field crops.

If there be any arguments for the establishment of agricultural stations, these arguments apply with much greater force to forestry stations. For most of the experiments of the former are of comparatively shorter duration, and are, therefore, not entirely beyond the reach of even private enterprise; while in forestry experiments the answer comes often only after many years, and hence private enterprise is deterred from undertaking them. This same argument, the length of time and necessity of persistence, speaks for an early beginning, even before the actual need for the answer exists, so that it be ready when called for.

Another point which makes the development of these stations desirable is, that at a time, not so distant as it would appear, the necessity for object-lessons in the field to serve to the students in your colleges, will appear. The absence of such in the Eastern States is beginning to make itself felt: To learn how to manage a wood crop, one must see a well-managed wood crop. But as such are not in existence in the United States, students have to go abroad for their object-lessons. This will do well enough for the Eastern States, with climatic conditions similar to Europe; but California differs so essentially that object-lessons at home will have to be worked out, and now is the time to begin on them.

As to the establishment of a station on Mount Hamilton, I am hardly in a position to express an opinion, except to say that your arguments would appear to me convincing. While I can conceive that concentrated effort at one station may produce greater result with proportionately less expenditure, the advantage should not be underrated which comes to the people by having several stations accessible, in addition to the fact that differences in the effect of soil and climate are best studied by a distribution of stations.

Hoping, for the sake of rational economics, that your efforts in convincing the authorities of the wisdom of your proposition, will be successful,

I am, very truly yours,

B. F. FERNOW.

The Proposed Mount Hamilton Station.—The allusion, in Professor Fernow's letter, to work at Mount Hamilton, requires further explanation. It is hoped by the friends of practical forestry that a third—a central California Coast Range station—may eventually be added to the two already established. The following memoranda from reports made to Professor E. W. Hilgard, the Director of the Stations, show briefly what has been done at that point:

"The plan to establish a forestry station on Mount Hamilton has developed from the tree-planting work of the Agricultural Department there, and as the result of our study of the remarkable adaptability of the place to forestry work.

"The first attempts to plant were near the Lick Observatory, in the poorest of shale, and on the most exposed situation, simply to obtain a small stand for future beauty and shelter. In 1889, a few trees were sent up from the University nurseries. Again, in 1890, several hundred deciduous and coniferous trees were planted; and still another collection was sent up in 1892. Many of these trees remain—of those species suited to the barren mountain top. Meanwhile, Professor Greene made a report on the flora of the region, and the Observatory studied the climatic conditions.

"On the top of the mountain (4,200 feet elevation), the least annual rainfall since 1880 was 13 inches, and the average rainfall is 33 inches. The lowest temperature was 13°; the highest, 90°. The place where it is proposed to establish a station is nearly 1,500 feet lower, well sheltered and well watered, having rich soil. Here nurseries can be commenced, and extensive and profitable plantations gradually extended up the slopes. The temperature on these sheltered slopes will probably not fall below 20°.

"The conclusions from a careful study of the 2,600 acres of the Mount Hamilton reservation, made at intervals during the past five years, are these: From the botanical, horticultural, and forestal points of view, the Mount Hamilton tract of land is very valuable, and ought to be utilized. Portions of it would, in time, yield some revenue. There are several warm 'flats'; and a thousand acres or more could, in time, be covered with as fine a coniferous forest as that which clothes the base of Shasta, mingled, as it should be, with the best species of oaks and other hard-wood trees. Such forests, the Director of the Lick Observatory assures us, would not injure, but would increase the astronomical value of the site.

"There is no better place in California for a forestry station of the first rank, to deal directly with the practical problems of reforestation, which the Nation and State are beginning to recognize as essential to our prosperity."

Trend of Forestry Legislation.—In all parts of the United States, the friends of forestry have been especially active during the past two years. Two very important bills before the last Congress, and favorably reported by committees, but failing to reach action, because of the shortness of the session, will be taken up again and pushed with vigor. The bills were introduced by Hon. E. J. Hainer, of the House of Representatives.

One of the Hainer bills amends the Morrill Act of 1890 in three essential particulars: First, it increases to the maximum the appropriation contemplated by the Act; second, it makes the appropriation absolute, instead of payable only out of the proceeds of the sales of public lands, thus making permanent the appropriation which, as the law now stands, must soon fail with the exhaustion of public lands; third, it adds $5,000 per annum to be applied to instruction in forestry, thus practically creating a new chair in each agricultural college, such as the College of Agriculture in the University of California. The other bill establishes a national school of forestry in connection with the Division of Forestry in the Agricultural Dapartment.

The reason for these bills is plain. "Our forests," as Mr. Hainer writes, "are disappearing. The ax wielded by industry, and the torch lighted by ignorance and carelessness, are rapidly completing the work of denuding the land of timber. The growth and conservation of new forests have been left largely to chance and time, for practically nothing has been done in this country to educate our people in this matter. A subject of such vast and growing importance, and vitally affecting, as it does, our climate, crops, and general prosperity, should be scientifically and practically treated. The establishment of forestry as a chair in our agricultural colleges, and the institution of a national school of forestry, make a long step in this direction, and will, it is hoped, meet a generous and hearty approval. The national school is intended to furnish a graduate course in forestry, and to act as a thought-suggester—a beginning or forerunner of a great national university in connection with the several departments and public institutions, which may utilize the magnificent libraries, museums, laboratories, collections, and numerous other means of information and instruction found at the capital city, and which cannot be aggregated elsewhere in this hemisphere. The aggregate of additional annual appropriations contemplated by these bills will not exceed one fifth the cost of a modern battleship."

THE CHICO STATION.

The Chico Station, though even more demoralized in 1893, when it came under University control, than the Santa Monica Station, had the advantage, from the first, of the very active coöperation of a large landholder and leading citizen, General John Bidwell, who had protested, in public and in private, for several years, against the manner in which the Station had been allowed to fall into wreck. The community has been most cordial and helpful; all the newspapers have supported the Station, and no unfriendly criticism of any kind has ever been made upon the Chico Station since 1893. The patron, Robert Pennell, Principal of the Chico Normal School, is a frequent visitor, and an active local representative of the Station; and the former patron, Colonel Royce, Manager of Rancho Chico, has been equally energetic. The number of visitors is increasing, the Station is becoming very attractive, and its value to the community is fully recognized. An immense amount of work is being done there, considering the limited appropriations. The trees, which were almost wholly unlabeled in 1893, are now neatly and accurately marked by large painted labels. Tree registers and weather statistics are properly and regularly kept by the foreman, and when we can afford the expense, a larger range of weather bureau instruments will be placed at the Station.

Description of Tract.—The twenty-nine acres of land, which constitute the Station, are beautifully situated a mile east of the town, toward the foothills, on rising ground, south of Chico Creek. The shape of the tract is nearly that of a triangle, extending southeast and northwest along Chico Creek, with the base toward the main valley. There are four different soils represented on the Station. The upper end, toward the foothills of the Sierra, consists of light, deep, rich, sandy alluvial soil, deposited by the creek. West of this lies a strip of medium adobe, part of which contains water near the surface. Still farther west is a belt of characteristic foothill soil, gravelly and red, a light slate soil, with occasional hardpan. The extreme western end of the tract, perhaps five acres, is the valley soil of the Sacramento, strongly modified by river deposits in time of flood. The best soils for farming purposes are those situated at the upper and the lower ends of the Station. The red, gravelly soil is fittest for conifers.

A water-flume extends along the western edge of the tract, and the soil under it is continually wet, which affords a good place for willows and water-loving shrubs. The Station also controls, for planting purposes, a superb avenue extending from the southwest corner of the tract to the town. Large locusts and some very large white oaks (*Quercus lobata*) already line portions of this avenue, and it is being planted with other oaks, while a collection of Japanese oaks, sent by Professor Sargent, of the Arnold arboretum, at Cambridge, Massachusetts, have been placed on the extension of the avenue within the grounds.

A second approach to the Station is by a winding road along Chico Creek. It is a very charming drive or walk at every season of the year, through one of the finest young oak groves in California. The vines of *Vitis Californica* here often climb to the tops of the sycamores. Perhaps a thousand acres of woodland extend north from near the forestry station, and form one of the most attractive features of Rancho Chico. In the center of a large, open glade, about a mile from the Station, is the famous Hooker oak. This very shapely and beautiful tree, greatly admired by Sir Joseph Hooker, when in California, is a *Quercus lobata*, whose dimensions, as measured by Mr. Boland, July 11, 1894, were as follows:

Circumference of trunk	20 feet.
Circumference of largest branch	15 feet 2 inches.
Spread of limbs from trunk, on south	73 feet.
Spread of limbs from trunk, on north	63 feet.
Spread of limbs from east to west	112 feet.
Approximate height	100 feet.

Interesting, as showing the differences of growth in this species of oak, are the measurements of a tree growing near Ukiah, Mendocino County. As taken by Mr. Carl Purdy and myself, they were as follows:

Circumference of trunk	24 feet.
Height of tree	132 feet.
Total spread of limbs, about	80 feet.

Plantings of 1894–95.—On so small a tract as twenty-nine acres, there cannot be any extensive forestry work. It is necessary here to do much testing of species, a few trees of each. This arboretum work is also desired by the Normal School classes. Ten or twelve acres can be planted to mixed high forest, using California conifers, together with the more promising foreign hard-woods for the district, preëminent among which are *Quercus robur* (var *pedunculata*), *Q. cerris*, and *Q. suber*. A little good coppice work is desirable, to teach farmers how to manage wood-lots, more and more necessary in many parts of California. About two acres of mixed forest has already been set, using what trees were in the nursery, and alternating conifers and deciduous trees in such a manner that the less valuable sorts will be cut out as more room becomes necessary. The loss was less than one fifth of one per cent, and the few gaps have been filled. The leading species planted in this mixed forest were the following: *Pinus Austriaca*, *Pinus strobus*, *Pinus Sabiniana*, *Pseu-*

dotsuga taxifolia, *Thuya gigantea*, *Negundo Californica*, *Tilia Americana*, *Juglans Californica*, *Celtis occidentalis*, *Catalpa speciosa*, *Ulmus suberosa*, and *Paulownia imperialis*.

Planting of specimen trees from various nurseries, imported, or grown from seed, was continued through the winter of 1894–95. Notes upon some of these will be found elsewhere in this report.

The Struggle with Johnson Grass.—The foreman, Mr. A. B. Boland, in his report, gives fuller details of his difficulties with the Johnson grass (*Sorghum halepense*), which covered fully one third of the tract. Near the trees, it had to be destroyed with mattock and shovel. About six acres is comparatively unplanted, and here the plow could be used to some extent in the heavy, matted sod. On the rest of the land, the Johnson grass was less abundant, but was still troublesome, and was increasing fast at the time the University obtained control. In three or four years more, had the previous neglect continued, the land would have been abandoned to the Johnson grass. Mere plowing and harrowing, however, even in the more open spaces, did not destroy the grass, but seemed only work thrown away. It was necessary to plow deep, in narrow furrows, and have a man follow in the furrow, and throw out all the roots loosened by the plow. These were piled up, and burned when dry. The operation was repeated three times before it was safe to depend upon ordinary plowing and harrowing out. From six acres, upwards of two hundred two-horse wagon-loads of grass roots were taken out of the soil before the pest was under control. When Johnson grass is to be destroyed on a large scale, two or three men should follow the plow, as it will keep them busy enough. One of the large road-making plows, with four horses, would be very effective for this work. A six-tined fork is the best. A horse-rake can be used to pile the roots. The grass should be allowed to grow a foot high before each plowing, as the green tops enable the workmen to fork out all the roots. But after the heavy work is done, using a sharp weed-cutter so continually that the plants never reach the surface is the only method of completing the destruction of Johnson grass.

Notes on Conifers.—All of the large collection of conifers appear to thrive on the red soil, except *Pinus sylvestris* (the Scotch pine), but the climate is too dry and hot for this species to succeed as well as some others. Still, *P. sylvestris* has much improved under cultivation in the past two years. In 1893, grown in hard, unbroken soil, covered with weeds and Johnson grass, the plantation of *P. sylvestris* presented a very poor appearance. The leaves were turning yellow; some branches were wholly withered, some trees were dead, and few were making any growth. With constant care since that time, the plantation is more healthy and beginning to improve. The hot days of July and August still give *P. sylvestris* a yellow appearance, but some trees look as robust as any of the pines on the Station. It has been suggested that seeds should be hereafter gathered from those specimens which best withstand the summer heat, to distribute in the Sacramento and San Joaquin Valleys. But it is probable that one of the causes of the comparative failure of this grove was in the use of pot-bound plants, poorly set, years ago, in Forestry Commission days. In very many cases, at Chico, conifers were planted several inches too deep; or too shallow, exposing the roots; or

Part of a Grove of Young Sequoia Gigantea Trees—Chico Forestry Station.

several were set in one place and allowed to twist themselves together; or sacked trees were planted without removing the sacks, so that the roots made bad growth. Such trees can never be considered as normal, and no fair estimate of the value of a tree to California can be made from such data.

The following table shows the comparative growth of some coniferous trees of presumably the same age, on the forestry station, during the season of 1894. The *Sequoia sempervirens* stood in the worst part of the Johnson grass sod, and hence made poor growth, but the trees are now doing better. In each case, an average specimen was measured. The trees are from five to seven years old, as nearly as can be ascertained. The lack of authentic early records is much to be regretted:

GROWTH OF CONIFERS AT CHICO STATION DURING SUMMER OF 1894.

Species.	Soil.	Height, April, 1894.	Height, Nov., 1894.	Summer Growth of 1894.
Abies balsamea	Gravelly, red foothill	24 inches	45 inches	21 inches.
Chamæcyparis Lawsoniana	Gravelly, red foothill	48 inches	8 feet	48 inches.
Cupressus sempervirens	Gravelly, red foothill	11 feet	15 feet	48 inches.
Pinus Austriaca	Dark, sandy	44 inches	72 inches	28 inches.
Pinus resinosa	Gravelly, red foothill	16 inches	40 inches	24 inches.
Pinus resinosa	Gravelly, red foothill	50 inches	106 inches	56 inches.
Pinus sylvestris	Gravelly, red foothill	64 inches	84 inches	20 inches.
Sequoia gigantea	Light adobe	10 feet	17 feet	7 feet.
Sequoia sempervirens	Light sandy	24 inches	48 inches	24 inches.

There are one hundred and twelve fine trees of *Sequoia gigantea*, and the average appearance is well shown by the illustration accompanying this report. The twenty-four *Sequoia sempervirens* do not thrive so well, but are improving now. The one hundred and seventeen Italian cypress were from poor seed, and show a wide range of types. The groups of *Pinus sylvestris* and *Pinus Austriaca* have greatly improved during the season of 1895, owing to continued cultivation. It seems almost unnecessary to say that no irrigation was practiced, even on the newly planted trees in the mixed forest. *Catalpa speciosa*, on light adobe soil, near the *Sequoia gigantea* grove, grew from a height of twelve to a height of sixteen feet. This comparison will serve to illustrate the extraordinary growth of the *Sequoias*.

Notes on Oaks.—After two years' experience, both in nursery and in forest, the adaptation of the English oak is manifest. It can be recommended for the Sacramento Valley for shelter and ornament. The acorns are, preferably, to be planted where the trees are to stand, but if not more than two years old, the tree moves well. A new growth of three or four feet is not uncommon the second year after replanting. Chico is in the heart of an inland oak country. Many of the best American and some European species are already represented on Rancho Chico, by large and stately trees. The American oaks at the Station are still small. The Japanese oaks do not well endure the summer heats. The best specimen is *Quercus glandulifera.* We have some difficulty in growing *Q. variabilis*, *Q. glomerata*, and *Q. crispula. Quercus glauca* promises well, but the fine *Q. Veitchii* is a failure. It seems too hot and dry at Chico for these island oaks, which are better suited to the Coast Range valleys. Of American oaks in the nursery, received by mail, from Thomas Meehan, Philadelphia, *Q. coccinea*, planted in January, 1895, had grown six inches in October; *Q. bicolor*, under similar conditions, grew three inches; *Q. imbricaria* grew nine inches; *Q. phellos* did badly. The English oaks (*Q. robur*, var. *pedunculata*) in the nursery, under similar conditions, made a growth of from twelve to twenty inches, and what is still more interesting, made two distinct growths in the season. The terminal buds often suffered in the case of this oak, as with others, and it is a hard tree to keep straight for the first four or five years. *Quercus incana*, a blue live oak from the Himalaya Mountains, promises to do well here. None of the oaks received any irrigation.

Notes on the Ash.—It has long been believed by students of Californian forestry that some of the Ashes should be planted for timber. The Chico Station is situated in an excellent ash region, large trees of *Fraxinus Oregana* being found within a hundred yards of the grounds. Small trees of this ash, together with *Fraxinus viridis*, are growing in the Station forest; but since neither species ranks as best for timber uses, it seemed desirable to test all the others. *Fraxinus viridis* is a less satisfactory tree at Chico than *F. Americana* (the American white ash). Trees three inches high, received through the mail in the spring of 1894, grew six inches that season, and four and a half feet in the season of 1895, to October 15th, when the foliage turned yellow and growth ceased. The trees are very straight, far better than *F. viridis*, and the growth is fully 50 per cent larger. Under these conditions in the Sacramento Valley, a grove of ashes planted close, and duly thinned as the trees shaded the ground, would become a valuable property. The true white ash would be the proper species to plant; the seed is extremely cheap and of easy growth.

Another very promising and new ash, never before grown in California, is *Fraxinus dimorpha*, of Algeria, sent by Dr. Trabút, Director of the experiment station there. *Dimorpha* is a charming species, most delicate in foliage, graceful in habit, and more resembles a sophora than an ash. We have one hundred and twenty trees, from seed sown in June, 1894, which came up in the spring of 1895. In October, 1895, the trees ranged in height from sixteen to twenty-seven inches. None of the ashes received any irrigation.

Notes on Willows.—One of the most interesting collections at the Station consists of the willows. Cuttings of twenty-four selected species were obtained in the spring of 1895, and planted in the nursery, but received no irrigation. The growth is thus more unusual, and the following memoranda possess an especial interest:

Salix alba, the well-known European white willow, is invaluable for any collection. The young leaves are peculiarly whitish, and it is a strong grower, furnishing wood fit for many useful purposes.

Salix caprea, of Britain, is a notable species, with elm-like leaves, and woolly, greenish bark. It grew seven and eight feet from the cuttings, throwing up many stems.

Salix cordata comes from North America, and is quite ornamental, with its whitish and green bark. It made a growth of about four feet, on the average.

Salix discolor is one of the smallest of the collection; its slender, regular, delicate shoots hardly average two feet.

Salix hippophaëfolia, a very distinct species with yellow bark and deeply serrate and wrinkled leaves, grew about three feet.

Salix Japonica, a fine, strong tree, with purplish bark, sent out shoots that reached a height of seven feet.

Salix Modeni has among the largest of the willow leaves, and is very ornamental. Its average growth was about four feet.

Salix pentandra, another English species, with very large, dark, smooth and glossy leaves, extremely ornamental, made a stocky growth, which averaged five feet.

Salix purpurea, the old English species, a small, sprawling plant, with a dark leaf, threw out many branches of an average length of one foot.

Salix salmonii, which is a native of the Levant, has beautiful stems, and slender, light-hued leaves. It threw up many stems, and their average length was ten feet in September—about six months' growth from the cuttings. Some stood twelve feet high when the frost came.

Salix sericea, with slender, reddish stems and bluish leaves, made three feet of growth.

Salix Sieboldii, of Japan, a choice species, light-green bark and slender leaf, threw out a dozen branches of an average length of six feet.

Salix villarsiana has narrow and curly leaves, and the shoots reach a height of seven feet.

Salix viminalis, another British species, shows two very distinct forms: the male, light green, glossy, a strong grower, of five or six feet; and the female, of the color of sagebrush, and considerably smaller.

Among the other *Salixes* in the collection were *S. daphnoides*, four feet growth; *S. alba vittellina*, four to eight feet; *S. dasyclades*, *S. regalis*, *S. lucida*, *S. serengeana*, and *S. caprea*, var. *cinerea*. The best of these, from an ornamental standpoint, are *S. dasyclades* and *S. lucida*.

The three best broad-leaved *Salixes* are *pendandra*, *caprea*, and *Modeni*. The three best for economic uses are probably *S. salmonii*, *S. alba*, and *S. Japonica*. The willows form a much neglected class of trees, of rapid growth and easy culture. They require moist soil, but not necessarily irrigation, as the Station experience sufficiently shows. Their ease of growth from cuttings, under proper conditions, is much in their favor. Over large areas of the State, the swamp and overflowed lands, and moist river bottoms, willows for fence posts, fuel, and other domestic uses are more valuable than most persons realize.

Growth of Other Trees.—*Caragana arborescens*, a curious, shrubby tree from Siberia, roots from cuttings as easily as a willow. Its growth is very rapid.

Morus multicaulis rooted better than any other mulberry. The mulberries thrive at the Station on dry soil.

The California sycamore, small trees transplanted from the woods in the spring of 1895, when eighteen inches high, were in September, 1895, five feet high, and four feet in spread of branches.

Ptelea trifoliata, received by mail when four inches high, in spring of 1894, grew fifteen inches in that year, and in the season of 1895 grew two feet more, making a total height of forty-three inches.

Sassafras officinale, received by mail in the spring of 1895, a single stem twelve inches high, was three feet high and thirty inches across by autumn.

Trees of American persimmon, from Florida, eight inches high when received, were four and a half feet high seven months later.

Betula lenta, small plants received by mail in spring of 1895, by autumn were four and a half feet high.

Acer platanoides and *A. campestre* made from four feet to five feet of growth under similar conditions.

Tilia Americana did poorly, throwing up side stems and losing terminal buds.

Ostrya Virginica, a very slow-growing tree in most cases, made a foot of new growth in six months, after being received by mail.

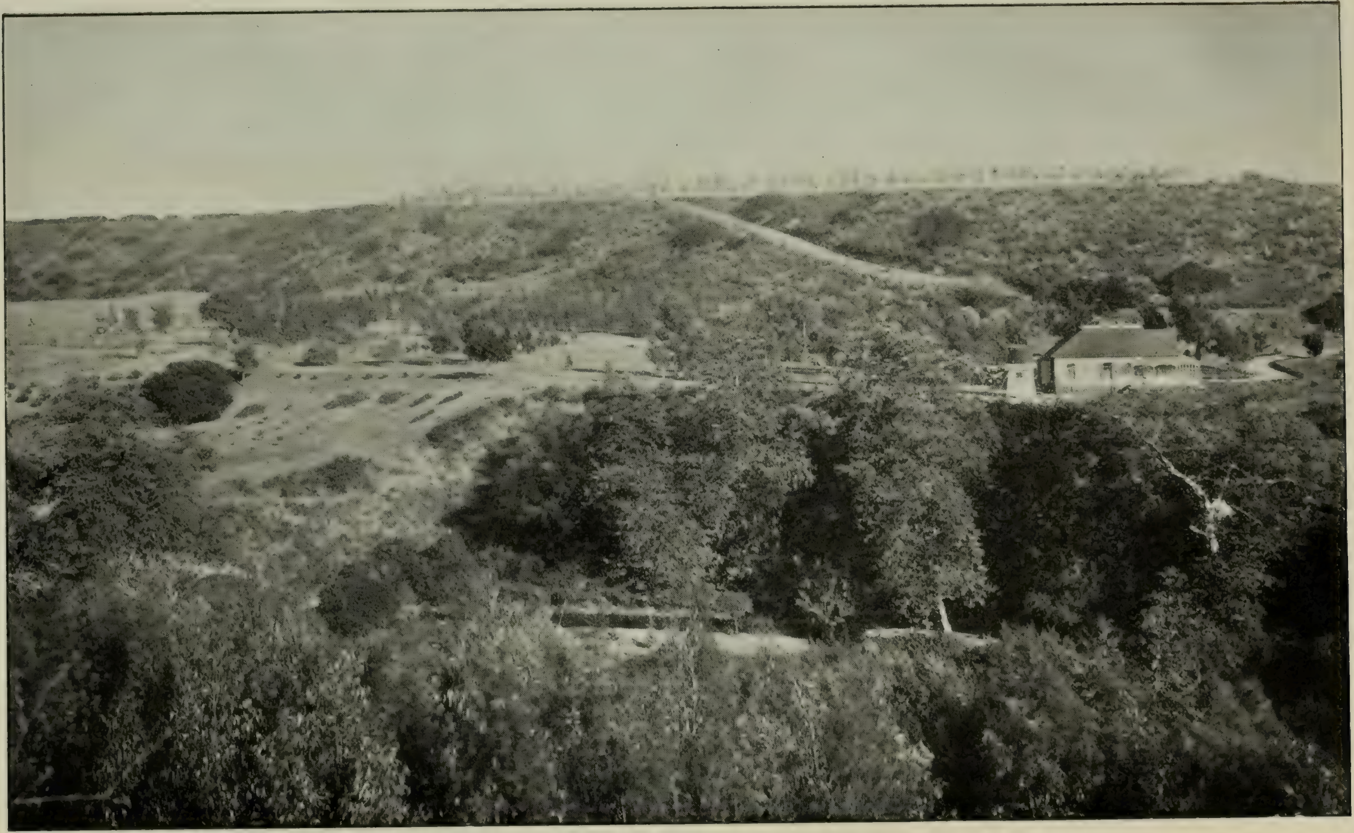
The only conifers which, so far, seem to require lath-house shelter here, are *Taxus Hibernica* and *Abies Menziesii.* The coniferous nursery is naturally well shaded by trees, so that other species do well, but these are not likely to thrive in the open, even when larger.

Improvements.—The permanent improvements of the last year consist of a convenient barn, stable, and wagon-shed under one roof, with a room for the foreman, so that he can now spend his nights on the grounds. This building cost nearly $300, and was twice built, as the first structure, begun May 27, 1895, completed June 30th, was, unfortunately, destroyed by fire before it was occupied—possibly by some tramp. It was immediately rebuilt, and was occupied by the foreman early in August. The facilities for growing plants from seed have been increased. A cottage should be built here in a year or two, as at our other stations, and a lath-house will be needed soon, though frames of glass and lath have been found sufficient for the present.

THE SANTA MONICA STATION.

The process of building up the wrecked Forestry Station at Santa Monica has been long and difficult, marked at times by more or less captious criticism from outside sources. The Santa Monica Station is now a credit to the State and the University, although the difficulties encountered in the work of reorganization there have been greater than were anticipated. The community in which the Station is located is a most excellent one, and various causeless assaults made upon its management so plainly show a selfish animus, and are so well understood by the public, that no injury has been done, or can be done, to the Station itself.

At Santa Monica, as at Chico, it is necessary to run the Station with one foreman, assisted by a laborer or two, and, during the season, when work is slack, the foreman may even be without assistance for several weeks at a time. By the usual close and manifold economies on the part of all the University officers, the planting of new species of trees is kept up, rare seeds are obtained and propagated, a large tract has been cleared of the native underbrush, and the foundations have been laid for very important observations in forestry, and the adaptation of different species to Southern California. The interpretation and comparison of various notes and observations of the foreman at Santa Monica, as at Chico, must necessarily be done by visits of botanists and other specialists from Berkeley, as well as by the Inspector upon his rounds of travel



View of Santa Monica Forestry Station Looking South, Showing the Three Levels

to all the stations. As the work grows, and as the friends of intelligent forestry form closer union, the funds will probably be obtained for more distinctly educational efforts at Santa Monica. In a few years more it will have a remarkably full and suggestive arboretum, accurately named and classified, and attractive in all respects to the botanist, the organic chemist, and every intelligent citizen. In the past two years it has been chiefly occupied in repairing the costly blunders of others. Valuable original work in forestry is not of a kind to make an immediate showing. All who wish to see the development of the Station should help to increase its financial resources, and to enlarge its tree collections.

Description of Station.—The forestry station at Santa Monica, in Southern California, occupies a most interesting and picturesque site. The town, Santa Monica, is perhaps as well known as any part of the California seacoast, because it is particularly accessible from Los Angeles by railroad, and has become the leading watering-place between Coronado and Monterey. A long sweep of seashore, bold, high cliffs, and an almost level plain above them, rising north and northeast to the bluest of mountain ranges, and traversed by deep barrancas, or straight-sided cañons—such is the general aspect of the great Santa Monica Rancho. Fifty years ago, a hundred thousand acres here, the estate of an old Spanish pioneer, supported vast herds of horses and cattle. Then came the railroad and the American town-builders. Senator Jones, of Nevada, and others bought the ranch, founded the town, pushed out an immense wharf a couple of miles away at Port Los Angeles, where steamships land, and Santa Monica, upon the frostless bluff, overlooking the blue Pacific, began to take shape. Now one sees there rows of tall bananas, heavy-fruited all winter long; tacsonias and passifloras grow and bloom; semi-tropical gardens surround costly cottages on every hand.

The greatest and deepest barranca in this entire Santa Monica plain is that known as the Santa Monica Cañon. It is not really a cañon in the strict interpretation of the Spanish word, which refers to mountain ravines, but more nearly conforms to the Spanish idea of a barranca—a wide cleft across the plains from the mountains to the sea. In reality, there are two large barrancas there, running in a direction somewhat parallel for four or five miles, although they are sometimes close together, and at other times wide apart. The narrow tongue of land between them extends to within an eighth of a mile of the ocean. The two streams of water that flow through these deep and well-wooded depressions unite at the foot of this gradually sloping tongue of land that overlooks the sea beaches. Here, on the sides and summit of this narrow, central plateau, between two deep gorges, the Santa Monica Forestry Station is situated. It is almost completely hidden from the town and the watering-place. It is greatly sheltered from storms, and yet the view from its heights is wonderfully extensive.

To a tourist driving northward from Santa Monica, along the cliff overlooking the Pacific, the dry, level plain seems to stretch unbroken, except by slight depressions, for twenty miles. Suddenly, by an old adobe ruin, he pauses at the verge of a cliff; a hundred and fifty feet below, the Santa Monica ripples over its pebbles and through its groves of giant sycamores, which rank among the noblest in Southern California. Half a mile beyond, the plain continues again on the same level; between the two divided fragments, a narrow tongue of rocky land projects and sweeps in long curves downward to the sycamore groves. Eastward, along the ascending lines of the vast chasm, are darker and larger masses of forest—walnut, oaks, cottonwoods, and other groves of sycamores. Beyond, and at points of vantage on the sides of the descent, are plantations and avenues of various species of eucalyptus. The cultivated fields cease at the edge of the gorge, and only begin again beyond the farther cliff; the space between, painfully cleared in spots, and planted with grass and corn, is, for the most part, wild land, thickly overgrown with lesser forms of vegetation, except where richer soil, or the nearness of water, has enabled native trees to gain a foothold.

The twenty acres belonging to the forestry station, a little arboretum tract, with hardly any waste upon it, extends from the bottom of the northern Santa Monica Cañon, up slopes and across levels to the very top of the mesa, on the same plane as the town itself, and looks down from thence to the bottom of the south cañon. There are thus three distinct levels and two half levels, with their connecting slopes, not too abrupt for planting. Such is the charming topography of the Station lands. Given five acres more of rough, stony, western frontage sloping to the sea, and ten acres towards the east, to carry the boundaries to natural lines, and the forestry station need ask nothing else in the way of land endowment.

The soil is rich and varied, suitable for good tree growth, and easy to till. Frosts, noticeable on the lower part of the tract, lessen as one ascends. Climatic observations are being kept on each of the three principal levels of the Station.

Species of Trees Planted.—Mere lists of species planted are seldom valuable. The phenomenal range of soil and climate offered to the forester here can best be shown by a few memoranda:

On the lowest and coldest level, three or four feet above the creek bed, are camphor trees, several hakeas, a banana, dracenas, an immense mass of the Hawaiian taro (*Caladium esculentum*), growing in the moist soil that receives the overflow from a hydraulic ram used to lift water to the dwelling-house, a hundred feet higher. Tender species of eucalyptus and other trees are grown in seed-beds here. The soil is a light, sandy loam, mixed with leaf-mold from the willows, cottonwoods, and sycamores that shelter and half surround the place.

The bluff between the lowest level and the main or cottage plateau is heavily wooded, except where nearly perpendicular. It is moist with springs, and green with vines and beautiful undergrowth. Here azaleas, rhododendrons, camellias, kalmias, magnolias, clematis, and similar species are being planted by the roadside, or in the small clearings in the rich loam at the base of a bluff. Broom and gorse are being naturalized higher up the bank. One still more sunny place, a hollow of rich, black, peaty soil, has been occupied by a score of fig trees of different varieties, and by clumps of bamboos. Olives, too, have been planted—fifty trees in eleven varieties.

The middle plateau, where the eucalypti and acacias are chiefly planted, also contains the beginnings of a palm collection, a *Jacaranda mimosæfolia* (one of the rosewood trees), and a large number of tender trees and shrubs. The soil is a loose, rocky loam, warm, light, and needing no irrigation for trees set early in the season. The growth of *Quercus cerris* and *Q. robur* have been most satisfactory. The scarlet

Creek Entrance to Santa Monica Forestry Station

hibiscus and the scarlet passiflora (*P. incarnata*) have not shown a sign of injury in winter. The native growths are *Quercus agrifolia*, *Rhamnus Purshiana*, *Juglans Californica*, and large elders, some of them thirty-five feet high, with trunks eighteen inches in diameter.

The second steep bluff, another hundred feet high, that lies between the middle plateau and the mesa, contains enough soil for trees and shrubs, and has been cleared preparatory to planting. This portion, as well as the top, requires great care to secure a tree-covering. It may be considered as fairly representative of an immense area of mesa land in California. The native growth is *Rhus laurina*, *Rhamnus Purshiana*, the so-called wild coffee-berry of California, with *Pæonia Brownii*, *Salvia spathacea*, and the inevitable host of *Compositæ*. In the springtime the mesa is very beautiful.

Several large rows of eucalypti border this upland; the middle portion of seven or eight acres is unplanted, except for some ash and olives, which have done very well; and here, rather than on the lower plateaus, the first scientific effort at establishing a mixed high forest will probably be undertaken as soon as the soil is in good condition and the trees ready. The cork oak (*Q. suber*) has done so well in Southern California, surpassing in rapidity of growth any other oak (and oaks are so well indicated by the native growth of the plateau), that a grove of cork oaks will probably be placed there. But the more valuable species of eucalyptus and acacia seem to be more nearly adapted to the mesa.

Growth of Eucalypti Without Irrigation.—The following memoranda will serve to illustrate the surprising adaptation of the mesa soils of Southern California to forest growths:

Seeds of *Eucalyptus callosa*, sent by Baron von Mueller, were sown in seed-boxes, in the spring of 1894. The resulting trees were planted in February, 1895, in gravelly soil, on the cottage plateau. At that time the average height of the plants was three inches, and none had more than four leaves. This species, like many other eucalypts, is of slow growth the first year. After being planted on the plateau, the trees received no irrigation. In seven months, the best trees were eight feet high, with a spread of branches over a circle four feet in diameter; the trunks of these trees were one and one half inches in thickness. The smallest trees of this species were two feet high.

Eucalyptus crebra, seed from the same source, and receiving similar treatment, made very fine trees, six feet in height.

Eucalyptus goniocalyx made extremely poor growth; and, comparatively speaking, has little to recommend it.

Eucalyptus Stuartiana, a beautiful species, with graceful, drooping branches, receiving the same treatment as above, reaches a height of four feet. The tree much resembles *E. goniocalyx*, excepting that the leaf is pointed instead of being notched at the end.

The poorest growth of all the Von Mueller seedlings was that of *E. obtusifolia*, a difficult species to start. The trees, when eighteen months old, receiving the same treatment as *E. crebra*, were but three inches high.

In these four species, thus tested under ordinary culture conditions, we have an interesting series for comparison. With *E. crebra*, a planter on mesa lands could reasonably depend on obtaining large trees in a few years. Cultivation of the soil is necessary to any extended success.

While eucalypts planted in brush and chaparral will, in some few cases, struggle up to maturity, far the greater proportion will be killed by gophers, squirrels, and summer droughts. It pays to cultivate forest trees for a few years in California. With cultivation, no irrigation is needed on thousands of acres of uplands.

The Large Eucalypts.—The plantation of eucalypts is beginning to assume shape. The following measurements were taken by the foreman, Mr. W. J. Strachan, in 1894, and again in 1895. The age of the trees is unknown, as no records were kept before the Station passed under University control, but it is said that most of the trees named below were planted in the ground in 1889 and 1890. In this case, allowing for the time required in nursery, all are now under seven years old:

MEASUREMENTS OF EUCALYPTS.

Variety.	Growth in 1894.	Growth in 1895.	Present Height.
Alpina (Lindl.)	2 ft.	2 ft. 6 in.	11 ft. 6 in.
Alpina (2)	1 ft.	1 ft. 6 in.	8 ft. 6 in.
Amygdalina (Labill.)	4 ft. 6 in.	6 ft. 3 in.	24 ft. 5 in.
Amygdalina (2)	3 ft. 3 in.	4 ft. 4 in.	22 ft. 4 in.
Buprestium (F. v. Muell.)	1 ft. 2 in.	2 ft. 1 in.	8 ft. 3 in.
Buprestium (2)	1 ft.	1 ft. 6 in.	7 ft. 4 in.
Calophylla (R. Br.)	3 ft. 3 in.	3 ft. 9 in.	12 ft. 4 in.
Citriodora	8 ft. 8 in.	9 ft. 5 in.	About 40 ft.
Citriodora (2)	3 ft. 3 in.	8 ft. 4 in.	About 31 ft.
Citriodora (3)	7 ft. 2 in.	8 ft. 6 in.	About 35 ft.
Citriodora (4)	5 ft. 6 in.	6 ft. 5 in.	About 32 ft.
Corymbosa (S. M.)	5 ft. 1 in.	6 ft. 4 in.	About 25 ft.
Corymbosa (2)	5 ft. 4 in.	6 ft. 2 in.	About 28 ft.
Corymbosa (3)	6 ft. 5 in.	6 ft. 1 in.	About 26 ft.
Corynocalyx (F. v. Muell.)	8 ft. 2 in.	8 ft. 5 in.	About 42 ft.
Corynocalyx (2)	5 ft. 1 in.	6 ft. 6 in.	About 31 ft.
Corynocalyx (3)	6 ft. 3 in.	6 ft. 3 in.	About 33 ft.
Corynocalyx (4)	9 ft. 2 in.	9 ft. 3 in.	About 31 ft.
Corynocalyx (5)	9 ft. 4 in.	9 ft. 5 in.	About 38 ft.
Cornuta (Labill.)	7 ft. 6 in.	6 ft. 8 in.	About 34 ft.
Decipiens (Endl.)	4 ft. 2 in.	6 ft. 6 in.	About 22 ft. 9 in.
Diversicolor (F. v. Muell.)	5 ft. 2 in.	6 ft. 4 in.	About 34 ft.
Diversicolor, var. callosa	8 ft. 9 in.	10 ft. 2 in.	About 38 ft.
Diversicolor (2)	6 ft. 5 in.	6 ft. 2 in.	About 30 ft.
Eugenoides	5 ft. 6 in.	7 ft. 6 in.	About 27 ft. 6 in.
Eugenoides (2)	3 ft. 2 in.	5 ft. 9 in.	About 23 ft.
Eximia (Schau)	6 ft. 4 in.	7 ft. 1 in.	About 18 ft. 6 in.
Eximia (2)	5 ft. 1 in.	5 ft. 4 in.	About 18 ft. 9 in.
Ficifolia (F. v. Muell.)	8 ft. 1 in.	7 ft. 3 in.	About 22 ft.
Ficifolia (2)	3 ft. 2 in.	3 ft. 1 in.	About 12 ft.
Ficifolia (3)	1 ft. 6 in.	6 in.	About 8 ft. 6 in.
Ficifolia (4)	6 ft. 3 in.	6 ft. 5 in.	About 21 ft.
Ficifolia (5)	2 ft. 6 in.	2 ft. 3 in.	About 14 ft. 9 in.
Globulus (Labill.)	10 ft. 3 in.	12 ft. 4 in.	About 42 ft. 6 in.
Gomphocephala (D. C.)	7 ft.	7 ft. 6 in.	About 28 ft.
Gomphocephala (2)	5 ft. 3 in.	5 ft. 6 in.	About 24 ft. 6 in.
Goniocalyx (F. v. Muell.)	3 ft. 4 in.	4 ft. 9 in.	About 21 ft. 6 in.
Gunnii (Hook)	7 ft. 2 in.	6 ft. 6 in.	About 25 ft. 6 in.
Gunnii (2)	10 ft. 4 in.	10 ft. 3 in.	About 50 ft.
Gunnii (3)	8 ft. 4 in.	10 ft. 4 in.	About 38 ft. 6 in.
Gunnii (4)	8 ft. 2 in.	10 ft. 3 in.	About 36 ft.
Gunnii (5)	8 ft. 6 in.	10 ft. 2 in.	About 46 ft.
Gunnii (6)	9 ft. 1 in.	8 ft. 4 in.	About 37 ft.
Lehmanni (Preiss.)	3 ft. 2 in.	4 ft. 5 in.	About 21 ft.
Lehmanni (2)	3 ft. 4 in.	4 ft. 6 in.	About 14 ft.
Lehmanni, var. stricta	5 ft. 4 in.	7 ft. 6 in.	About 22 ft.
Leptophleba (F. v. Muell.)	2 ft. 6 in.	3 ft. 9 in.	About 11 ft.
Leucoxylon (F. v. Muell.)	6 ft. 2 in.	6 ft. 8 in.	About 32 ft.
Leucoxylon, var. rosea	6 ft. 4 in.	6 ft. 10 in.	About 33 ft.
Macrorhyncha (F. v. Muell.)	1 ft. 6 in.	2 ft. 4 in.	About 9 ft.

EUCALYPTUS GROVE, MIDDLE BENCH, SANTA MONICA FORESTRY STATION

MEASUREMENTS OF EUCALYPTS—Continued.

Variety.	Growth in 1894.	Growth in 1895.	Present Height.
Macrorhyncha (2)	2 ft. 4 in.	5 ft. 3 in.	About 15 ft.
Macrorhyncha (3)	7 ft. 6 in.	8 ft. 8 in.	About 26 ft.
Marginata (Sm.)	1 ft. 6 in.	2 ft. 4 in.	About 11 ft.
Marginata (2)	2 ft. 3 in.	2 ft. 5 in.	About 12 ft. 6 in.
Marginata (3)	4 ft. 4 in.	5 ft. 10 in.	About 20 ft.
Melliodora (A. Cunn.)	7 ft. 3 in.	7 ft. 3 in.	About 33 ft.
Melliodora (2)	6 ft. 4 in.	7 ft. 4 in.	About 29 ft.
Melliodora (3)	5 ft.	5 ft. 6 in.	About 24 ft.
Obliqua (Lher.)	5 ft. 3 in.	5 ft. 4 in.	About 20 ft. 6 in.
Occidentalis (Endl.)	6 ft. 2 in.	6 ft. 6 in.	About 28 ft.
Occidentalis (2)	2 ft. 6 in.	3 ft. 3 in.	About 14 ft. 9 in.
Occidentalis (3)	2 ft. 4 in.	2 ft. 1 in.	About 13 ft. 6 in.
Paniculata (Sm.)	1 ft. 5 in.	2 ft. 5 in.	About 7 ft. 4 in.
Paniculata (2)	3 ft. 1 in.	3 ft. 4 in.	About 16 ft. 6 in.
Pauciflora (Sieb.)	9 ft. 4 in.	10 ft. 8 in.	About 28 ft. 4 in.
Planchoniana	3 ft. 3 in.	1 ft. 6 in.	About 11 ft. 5 in.
Platypus (Hook.)	5 ft. 4 in.	6 ft. 2 in.	About 31 ft. 6 in.
Polyanthema (Schau)	5 ft. 1 in.	8 ft. 7 in.	About 26 ft.
Polyanthema (2)	4 ft. 1 in.	4 ft. 3 in.	About 24 ft. 6 in.
Punctata	5 ft. 2 in.	6 ft. 1 in.	About 25 ft.
Regnans	5 ft.	5 ft. 4 in.	About 22 ft. 6 in.
Regnans (2)	5 ft. 4 in.	4 ft. 3 in.	About 22 ft.
Robusta (Sm.)	5 ft. 3 in.	5 ft. 10 in.	About 28 ft.
Robusta (2)	5 ft. 6 in.	5 ft. 8 in.	About 10 ft. 9 in.
Rostrata (Schlecht)	5 ft. 7 in.	7 ft. 3 in.	About 28 ft.
Rostrata (2)	7 ft. 10 in.	9 ft. 7 in.	About 34 ft.
Rostrata (3)	6 ft. 4 in.	8 ft. 4 in.	About 34 ft. 6 in.
Rostrata (4)	7 ft. 3 in.	9 ft. 6 in.	About 41 ft.
Rudis (Endl.)	6 ft. 3 in.	8 ft. 4 in.	About 22 ft. 4 in.
Rudis (2)	6 ft. 7 in.	7 ft. 6 in.	About 31 ft.
Saligna (Sm.)	7 ft. 3 in.	7 ft. 8 in.	About 30 ft.
Sewell's Red Gum	6 ft. 4 in.	6 ft. 4 in.	About 23 ft. 6 in.
Siderophloia (Benth.)	7 ft. 6 in.	7 ft. 3 in.	About 26 ft.
Siderophloia (2)	4 ft. 2 in.	5 ft. 7 in.	About 18 ft. 9 in.
Stuartiana (F. v. Muell.)	4 ft.	5 ft. 6 in.	About 25 ft.
Tereticornis (Sm.)	8 ft. 6 in.	8 ft. 4 in.	About 52 ft.
Tereticornis (2)	5 ft. 4 in.	6 ft.	About 34 ft.
Tetraptera (Turcz.)	5 in.	6 in.	About 6 ft. 4 in.

APPENDICES.

Donations to the Experiment Station.
The Library and Reading-Room of the Station.
Financial Statement.

DONATIONS MADE TO THE EXPERIMENT STATION SINCE JULY, 1894, WITH BRIEF NOTES.

Our many correspondents will find in this list a brief but cordial acknowledgment of their useful, and, indeed, invaluable services in securing for the Station, from time to time, so much that is new, rare, and worthy of experiment.

The system which we follow is very simple. There are now so many established sub-stations that we can at once send seeds, plants, buds, scions, cuttings, bulbs, trees, etc., to some suitable locality; or we can grow them at the Central Station. We do not sell any stock received, nor propagate for sale (thus we cannot enter into competition with nurserymen or seedsmen). We do not distribute, even to other experimenters, without the permission of those who send us the stock. In cases where a close restriction is placed upon any new variety, we keep it in our orchards under number, so that no subordinates can possibly discover its name or value. Our interest in new species and varieties of plants is scientific, not commercial.

Every person who sends seeds, scions, etc., to the Station receives all of our publications. Correspondence from florists, seed-growers, nurserymen, amateur collectors, orchardists, hybridizers, and other persons interested in new things, is always welcome.

Seedling fruits of every description are especially desired, but varieties of real promise and some local note are usually best to send us. Miscellaneous lots of untested seedlings should not be sent us until they have fruited. Full notes on the history of a new variety are desirable. Samples of the fruit can usually be sent by mail, if properly packed. We do not pay transportation charges on trees or fruit (except by previous agreement). The preferable way is to exchange new varieties with the Station for scions, etc., of other varieties in our orchards. We can send out everything in our collection, subject only to such restrictions as we have accepted in respect to certain varieties. Besides seedling fruits, we desire wild fruits, seeds of trees, shrubs, economic plants, etc., from all parts of the world, and also scions of standard fruits not yet in our collections.

PLANTS AND TREES RECEIVED.

From Mr. John Rock, of the California Nursery Company, Niles, Cal.:

A collection of seedling Australian fruits, of much interest, being the first fruit of any size brought to California; also, two large grafted fig trees (in boxes), Smyrna and Capri, being top-grafted together to aid fertilization; also, two large plants of *Phœnix Canariensis*, in boxes; also, scions, cuttings, etc.; also, shipments of olives for experiment.

From George Roeding, of the Fancher Creek Nurseries, Cal.:

Scions of West Mammoth quince.

From Giles E. Chittenden, of Niles, Cal.:

Scions of three varieties of pears, one apple, and one peach, from an old orchard at Cumming, Mendocino County.

From S. L. Watkins, "Oak Leaf Nurseries," Grizzly Flats, Cal.:

Plants of Sonoma dewberry, three new seedling apples, and a number of small fruits.

From George Ruedy, of Colfax, Washington:

Trees of Palouse apple; scions of Colfax apple, of Stewart's Ironclad peach, of Moore's Arctic plum, and of an unnamed seedling plum.

Scions of other new fruits, on several occasions, and small trees by mail, have come from Mr. Ruedy, who has been of service to the Station in many ways during the past few years. The Station is now collecting all the "Ironclad" fruits obtainable, for an orchard at one of the sub-stations.

From Fred E. Young, Nurseryman, Rochester, N. Y.:

Tree of the Walter Pease, a new winter apple, and scions of Bourgeat quince, one of the finest of recent introductions from France.

Mr. Young has several times sent other scions, without charge.

From Supt. Thomas Sharpe, Government Experiment Station, Agassiz, B. C.:

Scions of some fifty varieties of apples and pears, many of them new to California orchards, and including a few of the new Canada seedlings, some new Russian fruits, and some of the old English and French varieties.

From the Oregon Wholesale Nurseries, Salem, Or.:

One Lambert cherry, two Surprise apple trees, and numerous scions.

The Lambert cherry, received under restriction, is a fine new Oregon variety, which originated near Portland, and is said to be the largest and finest cherry in Oregon.

From J. T. Bearss, of Porterville, Cal.:

Trees of the "Wonderful" pomegranate, a very large, deep purple and red variety from Florida.

From Hon. L. E. Pratt, of Salem, Or.:

Scions of a fine new seedling autumn and early winter pear, known as the Pratt of Oregon, and not yet disseminated.

From the U. S. Department of Agriculture, Division of Pomology:

Cuttings of Corsican citron, from near Ajaccio; said to be of the best variety on that island.

From Wm. Parry, Pomona Nurseries, Parry, N. J.:

Scions of new fruits, especially chestnuts, sent on several occasions.

From J. C. Shinn, Niles, Cal.:

Plants, bulbs, and scions.

From Mrs. P. M. W. Blair, of Piedmont, Cal., and donated to the Santa Monica Forestry Station in particular:

Plants and bulbs of some forty species, chiefly ornamental, and from one to two dozen specimens of each—a very desirable addition to the resources of that Station.

From the Rogers Nursery Company, Morristown, N. J.:

Scions of several new apples, and trees of a new pear.

From D. S. Lake Nurseries, Shenandoah, Iowa:

Scions of several new fruits.

From Stark Bros., Nurserymen, Louisiana, Mo.:

Scions of twelve new apples, and two new pears; not yet distributed to the trade.

From Brown Bros., Nurserymen, Rochester, N. Y.:

Scions of a number of apples and pears.

From T. V. Munson, Nurseryman, Denison, Texas:

Scions of several new fruits, mostly Texas Seedlings.

From the Silas Wilson Company Nurseries, Atlantic, Iowa:

Scions of three varieties of apples.

From the Geneva Nurseries (Youngers & Co.), Geneva, Nebraska:

Scions of several fruits.

From Prof. J. L. Budd, Iowa Agricultural College:

Scions of a number of new Russian apples.

From Robt. J. Bullock and W. W. Broughton, of Lompoc, Cal.:

Scions and specimens of two new seedling apples—one a green sweet, the other a very golden and large autumn apple of Bellflower type.

From P. J. Berckmans, "Fruitland Nurseries," Augusta, Ga.:

Several new economic plants and scions.

From Dr. J. Stayman, of Leavenworth, Kan.:

Cuttings of a number of varieties of American grapes.

From John Saul, Nurseryman, Washington, D. C.:

Scions of several new apples.

From J. E. Normand, Marksville, La.:

A number of trees of valuable new plums, figs, etc.

Mr. Normand is one of the most energetic helpers in the difficult effort to correct the nomenclature of the Japanese plums, and his collection will be of much service.

From Luther Burbank, Santa Rosa, Cal.:

Scions of many interesting and instructive hybrids of fruits.

From Mrs. Theodosia B. Shepherd, Ventura, Cal.:

Several plants for the Pomona Station.

From Mrs. E. S. Pond, of Berkeley, Cal.:

A fine collection of tuberous Begonias, and a collection of Irises.

From G. L. Taber, of Glen St. Mary, Fla.:

Scions of several varieties of fruit.

SEEDS.

From Baron Ferd. von Mueller, Melbourne, Australia:

Collections of tree and economic seeds, sent upon many occasions. These collections, always chosen with rare skill and knowledge of California conditions, still further emphasize the fact that the State owes a debt of gratitude to this famous botanist, who has, for a quarter of a century, sent seeds and plants to the University, and has been the means of introducing many extremely useful cultures here.

From E. L. Horton, East Steamburg, N. Y.:

Seeds of a fine double Rose poppy; (since distributed).

From A. Blanc, of Philadelphia, Penn.:

Japanese lawn grass seed.

From Edward Lester, of Pasadena, Cal.:

An edible-podded garden pea.

From the Florida Experiment Station:

The McNeil pea; a variety of local reputation.

From F. Desmesmay, of France, through the Western Beet-Sugar Company, of Watsonville:

Four sacks of sugar-beet seed, marked by numbers, for testing. This seed was distributed to selected correspondents throughout California.

From Dr. Franceschi, of Montecito, Cal.:

Seeds of the orache, or sea-purslane; a variety of *Atriplex hortensis*, from Kabyle.

From W. Atlee Burpee, seedsman, of Philadelphia, Penn.:

Seeds of new vegetables and of economic plants. Several large collections have been received from this prominent firm, and distributed to the sub-stations.

From Delano Moore, Presque Isle, Aroostook County, Maine:

Seeds of a new tomato and a new cucumber. These Northern-grown seeds prove well adapted to California, particularly the cucumbers.

From Mr. Leckenby, Superintendent of the Kern Valley Experiment Station, a private station conducted under the auspices of the Kern Valley Land and Water Company:

Seeds of *Modiola decumbens*, and a collection of beans from China; also, roots of various *Rumexes*, etc.

From the Department of Agriculture, Washington, D. C.:

Seeds of a white rhubarb, from Nova Scotia.

From W. Thompson, of Ipswich, England (through a California correspondent):

Seeds of three new Central African plants.

From D. E. Josephi, of San Francisco, Cal.:

Seeds of *Panicum crus-galli.*

From A. J. Reynolds, of New South Wales:

A collection of Australian tree and shrub seeds.

From William Farrar, of New South Wales:

A number of new cross-bred wheats.

From the Canadian Department of Agriculture (William Saunders, Director, Ottawa):

A choice collection of crosses of cereals. These have proved very interesting, but require further testing.

From the editors of "Garden and Forest":

Nut of the "Souari" tree of South America; also, "Paradise Nuts" (the Sapucaia) of the same region. Possibly these may thrive in California.

From the Botanical Department of the University of California:

Several collections of seeds—one from Natal, South Africa; another from Queensland, India, and Europe; others, miscellaneous, largely trees, shrubs, and economic. Most of these were sent to the sub-stations.

From the Botanical Gardens, University of Tokio:

A collection of thirty-seven species of Japanese tree and shrub seeds.

From J. C. Mohr, Mount Eden, Cal.:

Seeds of *Chamærops excelsa.*

From Prof. George King, Superintendent Royal Botanical Gardens, Calcutta, India:

Seeds of *Bassia latifolia*, *Ficus infectoria*, and *Santalum album.*

From H. W. Buckbee, Rockford, Ill.:

Ten packets of flower seeds, and twenty-seven packets of garden seeds. Nearly all distributed to the sub-stations.

From Mr. Ansel Tyler, Nottawa, Mich.:

Seeds of native American trees and shrubs. A good collection, including several hickories, oaks, ashes, etc.

From A. J. Reynolds, Balmaine, New South Wales:

Fifteen species of Australian tree seeds.

From John Bodger & Son, Santa Paula, Cal.:

A valuable collection of California-grown flower seeds, chiefly Stocks and Zinnias.

From Carl Purdy, Ukiah, Cal.:

Seeds of several native trees.

From H. M. Sanborn, Nurseryman, Oakland, Cal.:

Seeds for Santa Monica Station. Several packets for the garden.

From S. Nolan, Oakland, Cal.:

Seeds of a number of rare species of trees and shrubs.

From Mrs. Theodosia B. Shepherd, Ventura, Cal.:

Seeds of several new varieties of flowers for the sub-station gardens.

From A. Neustadt, 1502 California Street, San Francisco, Cal.:

Seeds of "Rosella" (*Hibiscus subdariffa*). This new fruit-producing plant proves very successful at the sub-stations, so far as tested.

From Miss Mary Ann Horner, of the Hawaiian Islands:

Seeds of the famous Koa tree, which has long been desired by the Forestry Stations.

THE LIBRARY AND READING-ROOM OF THE CENTRAL EXPERIMENT STATION.

This is an age of specialist publications, and much that is of very great value only appears in pamphlets and periodicals. The Agricultural Department receives all the publications of the experiment stations in the United States and other countries. These alone constitute a large and growing body of interesting scientific literature in many languages besides English. France, Germany, Spain, Italy, Russia, Algeria, Australia, British India, Brazil, and many other countries are represented here. Besides the reports of the stations, there are pamphlets published by various Governments, Commissions, and Departments in different countries, all bearing upon some department of agriculture. Nowhere else on the Pacific Coast can some of these publications be found on file.

Through the courtesy of editors and publishers the reading-rooms are supplied with a large number of dailies, weeklies, and monthlies, which are kept on file, and constantly referred to by students and instructors. The publications of the Department are sent in exchange, but in many cases the cost of the publications received far exceeds that of the bulletins sent out. We desire to return thanks to the kind friends who have contributed to the growth of our library and reading-room.

NEWSPAPERS RECEIVED AT STATION READING-ROOM.

CALIFORNIA.

Daily Encinal, Alameda, Alameda County.
Daily Advocate, Berkeley, Alameda County.
Washington Press, Irvington, Alameda County.
Weekly Herald, Livermore, Alameda County.
The Alameda Daily Argus, Alameda, Alameda County.
Oakland Tribune (daily), Oakland, Alameda County.
Oakland Weekly Enquirer, Oakland, Alameda County.
Amador Ledger, Jackson, Amador County.
Amador Dispatch, Jackson, Amador County.
Oroville Register, Oroville, Butte County.
Enterprise, Chico, Butte County.
Colusa Sun, Colusa, Colusa County.
Contra Costa Gazette, Martinez, Contra Costa County.
Weekly Expositor, Fresno, Fresno County.
Weekly Republican, Fresno, Fresno County.
Selma Irrigator, Selma, Fresno County.
Merced Express, Merced, Merced County.
Willows Journal, Willows, Glenn County.

Enterprise, Ferndale, Humboldt County.
Inyo Independent, Independence, Inyo County.
Lake County Bee, Lakeport, Lake County.
California Cultivator and Poultry Keeper, Los Angeles, Los Angeles County.
Rural Californian, Los Angeles, Los Angeles County.
Weekly Herald, Los Angeles, Los Angeles County.
L'Union Nouvelle, Los Angeles, Los Angeles County.
Le Progrès, Los Angeles, Los Angeles County.
Weekly Times, Pomona, Los Angeles County.
Santa Monica Outlook, Santa Monica, Los Angeles County.
Lancaster Gazette, Lancaster, Los Angeles County.
Pomona Progress, Pomona, Los Angeles County.
Pasadena Weekly Star, Pasadena, Los Angeles County.
Los Angeles Saturday Times, Los Angeles, Los Angeles County.
Los Angeles Record, Los Angeles, Los Angeles County.
Inyo Register, Bishop, Inyo County.
Weekly Adin Argus, Adin, Modoc County.
Marin Journal, San Rafael, Marin County.
Mendocino Beacon, Mendocino, Mendocino County.
Daily Madera Mercury, Madera, Madera County.
Weekly Index, Salinas, Monterey County.
Gonzales Tribune, Gonzales, Monterey County.
Weekly Register, Napa, Napa County.
The Evening Telegraph, Grass Valley, Nevada County.
Foothill Tidings, Grass Valley, Nevada County.
Truckee Semi-Weekly Republican, Truckee, Nevada County.
Press and Horticulturist, Riverside, Riverside County.
Weekly Bulletin, San Francisco.
Weekly Chronicle, San Francisco.
Weekly Examiner, San Francisco.
Weekly Post, San Francisco.
California Daily Demokrat (German), San Francisco.
Pacific Rural Press, San Francisco.
California Orchard and Farm, San Francisco.
California Fruit-Grower, San Francisco.
Daily Weather Bulletins, U. S. Weather Bureau, San Francisco.
Wood and Iron, San Francisco.
The Star, San Francisco.
Shasta County Democrat, Redding, Shasta County.
Dixon Tribune, Dixon, Solano County.
Vacaville Reporter, Vacaville, Solano County.
Santa Rosa Republican, Santa Rosa, Sonoma County.
Sonoma Friday Tribune, Sonoma, Sonoma County.
Tribune, Healdsburg, Sonoma County.
Mountain Messenger, Downieville, Sierra County.
Sutter County Farmer, Yuba City, Sutter County.
Chino Valley Champion, Chino, San Bernardino County.
Ontario Record, Ontario, San Bernardino County.
The Citrograph, Redlands, San Bernardino County.
Colton Chronicle, Colton, San Bernardino County.
Weekly Times-Index, San Bernardino, San Bernardino County.
Escondido Times, Escondido, San Diego County.

Templeton Advance, Templeton, San Luis Obispo County.
Arroyo Grande Herald, Arroyo Grande, San Luis Obispo County.
Paso Robles Record, Paso Robles, San Luis Obispo County.
Times-Gazette, Redwood City, San Mateo County.
Daily Independent, Santa Barbara, Santa Barbara County.
Lompoc Record, Lompoc, Santa Barbara County.
The Press, Santa Barbara, Santa Barbara County.
Gilroy Gazette, Gilroy, Santa Clara County.
Pajaronian, Watsonville, Santa Clara County.
Los Gatos Mail, Los Gatos, Santa Clara County.
Daily Herald, San José, Santa Clara County.
Fanciers' Monthly, San José, Santa Clara County.
California Prohibitionist, San José, Santa Clara County.
Pacific Tree and Vine, San José, Santa Clara County.
Oakdale Graphic, Oakdale, Stanislaus County.
Corning Observer, Corning, Tehama County.
Porterville Enterprise, Porterville, Tulare County.
Tulare County Register, Tulare, Tulare County.
Tulare County Times, Tulare, Tulare County.
Exeter Penny Press, Exeter, Tulare County.
Tulare Valley Citizen, Tulare, Tulare County.
Travers Advocate, Travers, Tulare County.
Ventura Free Press, Ventura, Ventura County.
The Ojai, Nordhoff, Ventura County.
Santa Paula Chronicle, Santa Paula, Ventura County
Weekly Venturian, Ventura, Ventura County.
Four Corners, Wheatland, Yuba County.

OTHER STATES.

Florence Herald, Alabama.
Daily Herald, Phœnix, Arizona.
Florida Agriculturist, DeLand, Florida.
Florida Farmer and Fruit-Grower, Jacksonville, Florida.
Southern Farmer, Athens, Georgia.
Southern Cultivator and Industrial Journal, Atlanta, Georgia.
Agricultural South, Atlanta, Georgia.
American Florist, Chicago, Illinois, and New York.
Farm and Home, Chicago, Illinois, and Springfield, Massachusetts.
Farm, Field, and Fireside, Chicago, Illinois.
Farmers' Review, Chicago, Illinois.
The Farmer's Magazine, Springfield, Illinois.
The Elgin Dairy Report, Elgin, Illinois.
American Corn and Hog Journal, Sibley, Illinois.
Park and Country, Chicago, Illinois.
The Agricultural Epitomist, Indianapolis, Indiana.
The Homestead, Des Moines, Iowa.
Wallace's Farmer, Ames, Iowa.
The Industrial American, Lexington, Kentucky.
The Louisiana Planter, New Orleans, Louisiana.
Turf, Farm, and Home, Watsonville, Maine.
Baltimore Weekly Sun, Baltimore, Maryland.
Maryland Farmer, Baltimore, Maryland.
American Cultivator, Boston, Massachusetts.

New England Farmer, Boston, Massachusetts.
The Farm Poultry Monthly, Boston, Massachusetts.
Grange Visitor, Lansing, Michigan.
Colman's Rural World, St. Louis, Missouri.
Mirror and Farmer, Manchester, New Hampshire.
Southwestern Farm and Orchard, Las Cruces, New Mexico.
Stock Grower, Las Vegas, New Mexico.
Weekly New Mexican Review, Santa Fe, New Mexico.
Brooklyn Grocers' Gazette, Brooklyn, New York.
American Agriculturist, New York City, New York.
Mercantile and Exchange Advocate, New York City, New York.
Scientific American, New York City, New York.
Weekly Tribune, New York City, New York.
American Gardening, New York City, New York.
Vick's Illustrated Monthly Magazine, Rochester, New York.
American Bulletin and Scientific Farmer, Cincinnati, Ohio.
Farm and Fireside, Springfield, Ohio.
North Pacific Rural Spirit, Portland, Oregon.
Northwest Pacific Farmer, Portland, Oregon.
The Rural Northwest, Portland, Oregon.
Oregon Agriculturist, Portland, Oregon.
Germantown Telegraph, Germantown, Pennsylvania.
Ladies' Home Companion, Philadelphia, Pennsylvania.
Practical Farmer, Philadelphia, Pennsylvania.
The Sugar Beet, Philadelphia, Pennsylvania.
The American Fertilizer, Philadelphia, Pennsylvania.
Journal American Chemical Society, Easton, Pennsylvania.
Naturalist's Monthly Bulletin, Philadelphia, Pennsylvania.
Successful Farmer, Sioux Falls, South Dakota.
Texas Farm and Ranch, Dallas, Texas.
Texas Stockman, San Antonio, Texas.
Holstein-Friesian Register, Battleboro, Vermont.
Daily Post-Intelligencer, Seattle, Washington.
Northwest Horticulturist, Tacoma and Seattle, Washington.
Hoard's Dairyman, Fort Atkinson, Wisconsin.
Church-Farm, Salt Lake City, Utah.

FOREIGN.

Agricultural Gazette of New South Wales, Sydney, N. S. W., Australia.
Garden and Field, Adelaide, S. A., Australia.
Tiroler Landwirtschaftliche Blaetter, St. Michæl, Austria.
Natural Food, London, England.
Le Bas-Rhône, Paris, France.
Gazette Des Champs, Marseilles, France.
Revue des Sciences Naturelles Appliquées, Paris, France.
Revue de Viticulture, Paris, France.
Deutsche Landwirtschaftliche Presse, Berlin, Germany.
La Agricultura, Guatemala.
Bolletino Mensile di Bachicoltura, Padova, Italy.
Bolletino di Viticoltori Italiani, Rome, Italy.
Konigl. Landt-Brucks Akadamiens Handligar och Tedskrift, Stockholm, Sweden.
Journal of Council of Agriculture, Tasmania.

THE AGRICULTURAL EXPERIMENT STATIONS OF THE UNIVERSITY OF CALIFORNIA, IN ACCOUNT WITH THE UNITED STATES APPROPRIATION, 1894-95.

			Cr.	Dr.
1895.				
	To receipts from the Treasurer of the United States as per appropriation for fiscal year ending June 30, 1895, as per Act of Congress approved March 2, 1887		------------	$15,000 00
June 30,	By Salaries	Abstract 1	$5,829 96	
	Labor	“ 2	3,417 96	
	Publications	“ 3	381 97	
	Postage and stationery	“ 4	394 97	
	Freight and express	“ 5	255 39	
	Heat, light, and water	“ 6	766 04	
	Chemical supplies	“ 7	300 46	
	Seeds, plants, and sundry supplies	“ 8	425 32	
	Fertilizers	“ 9	346 48	
	Feeding-stuffs	“ 10	309 73	
	Library	“ 11	92 76	
	Tools, implements, and machinery	“ 12	374 31	
	Furniture and fixtures	“ 13	92 50	
	Scientific apparatus	“ 14	696 07	
	Live-stock	“ 15	127 25	
	Traveling expenses	“ 16	651 35	
	Contingent expenses	“ 17	73 50	
	Building and repairs	“ 18	463 98	
	Balance		------------	
	Totals		$15,000 00	$15,000 00

We, the undersigned, duly appointed Finance Committee of the Corporation, do hereby certify that we have examined the books and accounts of the Agricultural Experiment Stations of the University of California, for the fiscal year ending June 30, 1895; and that we have found the same well kept and classified as above, and that the receipts for the year from the Treasurer of the United States are shown to have been $15,000, and the corresponding disbursements $15,000; for all of which proper vouchers are on file and have been by us examined and found correct.

And we further certify that the expenditures have been solely for the purposes set forth in the Act of Congress approved March 2, 1887.

A. S. HALLIDIE,
ALBERT MILLER,
I. W. HELLMAN, Sr.,
Finance Committee.

I hereby certify that the foregoing statement is correct, as shown in the books of the Agricultural Experiment Stations of the University.

JOHN J. HERR,
Auditor.

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